COMMITTEE WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of:	)	
	)	
Ad Hoc Integrated Energy	)	
Policy Report Workshop On	)	Docket No.
World Oil Supply	)	02-IEP-01
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CALIFORNIA ENERGY COMMISSION

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HEARING ROOM A

SACRAMENTO, CALIFORNIA

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9:15 A.M.

Reported by:
Peter Petty
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COMMISSIONERS PRESENT

James D. Boyd, Presiding Member

William J. Keese, Associate Member

STAFF PRESENT

David Abelson, Chief Counsel s Office

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Jim Page, Transportation Energy Division

Scott Matthews, Transportation Energy Division

ALSO PRESENT

Dr. Alfred J. Cavallo, Independent Consultant

Blake Eskew, Purvin & Gertz

Mark Finley, BP

Dr. Donald Gautier, U.S. Geological Survey

Sarah A. Emerson, Energy Security Analysis, Inc.

Kathryn Phillips, CEERS

Dr. Michael Smith, The Energy Network

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P R O C E E D I N G S

9:15 a.m.

PRESIDING MEMBER BOYD: We like to record these things for the benefit of the staff who has to sort out lots of the issues and write the reports, both for the Commission and for the public, and without the gentleman running the machine down here, none of us, you know, even our engineers can figure it out. So, he s here, and as he was for two solid days last week, as I was in this same Chair for workshops last Thursday and Friday, so it s getting to be catching.

Anyway. Good morning, and welcome to our World Oil Supply Integrated Energy Policy Report Committee Workshop. Let me provide with a little context and background. The Integrated Energy Policy report is a report this Commission is requested to provide by our legislature. The first report is due November of this year in which we have to assess policy issues relative to all energy sources, and we ve broken that down to mean electricity, natural gas, transportation fuels, and kind of a fourth category of public interest energy issues.

The workshop today, therefore, is one of the series of workshops related to this -- to our preparation of the Integrated Energy Policy Report.

For those who don t know, and I don t see a soul out there in the audience that I don t know for the most part, I m Commissioner Boyd. This is -- And I m Chairman of the Ad Hoc Committee that s required to put this report together. With me is Chairman of the Energy Commission, Chairman Keese, who is the second member of this Committee. And we will be hosting and chairing this workshop. It s going to help us develop the record we need to provide that report -- part of our report on transportation fuels.

The issue today is, quite obviously, the adequacy of World Crude Oil supplies upon which the State Transportation Sector currently depends, and very heavily, as we know in this state. We re the world champion in consumption of the product, I think.

The Commission recognizes that the assumption of continually increasing future oil production has been channeled by numerous analysts, and therefore, we convened this Panel of experts to help us explore the various dimensions of that question and of the issues.

We don t expect to come out of this workshop with a definitive conclusion on future oil production, although that would be interesting, but not probably highly likely. We do want to better understand the relationships between future oil production and, you know, the world conventional oil resources and their locations, perhaps the availability of unconventional oil resources, natural gas and oil substitutes, a better handle on the demand for transportation of fuels, what technological innovations might be there on the horizon, and just kind of an overall understanding of the operation of oil markets and oil prices, although I don t expect anybody to totally understand that subject since we spent so much time trying to understand it ourselves lately. Maybe we can get some insights today.

We want to better understand the implications of certain driving forces for California, including areas of risk and uncertainty, like any potential impacts on our state of market power in this arena where future prices might be going -- price volatility, which is always a question we deal with. More importantly, perhaps, the impacts of world demand growth and the implications of future fuel mix for infrastructure purposes.

Our speakers will open with presentations per the agenda, and then later in the day we ll have a panel discussion that s open to all of the speakers and to members of the audience. This is just a workshop, and we solicit clarifying questions at the end of each presentation.

And then towards the end of the day, as we have our open panel discussion, the opportunity for broad ranging questions upon any of the subjects or any related subject that you in the audience might want to provide to us or to the panel or put to us.

I would particularly like to thank Chuck Mizutani, who is sitting here at the table, who is going to help moderate the panel this afternoon, and Jim Page, who is out there, there he is, for putting all the effort into putting this workshop together.

I m going to introduce the members and give you a little biological sketch, maybe more than they desire, maybe less than they desire. It s up to me to stumble over that. And then we ll move right into the agenda and their various presentations.

We have Dr. Donald Gautier. He received his Ph.D. in Geology from the University of Colorado. He began working for the USGS as a research geologist. He has served as a chief of their oil and gas resources branch. He has designed, organized and implemented the national assessment of the United States Oil and Gas Resources. He s been the chief scientist of the Western Geological Mapping Team, and is currently working on the world energy project and the National Oil and Gas Assessment Project with emphasis on the growth and reserves and existing oil and gas fields worldwide.

We have Dr. Michael Smith. Mr. Smith received his Doctorate in Geology from Oxford University. He worked for several years as a consultant for the energy advisors Gaffney, Cline & Associates with a focus on the Far East. He later joined Croft Exploration in Glasgow as chief geologist with responsibilities for the United Kingdom and the Asian Pacific regions. He s worked for Sun Oil in London focusing on Eastern Europe and the Soviet Union, as well as exploration manager of Sun s Yemen operations. He s currently an independent consultant developing an internet based information service called Energy Files, something for the staff to subscribe to one day when it s done, right? Of course, you re dealing with a state of a $34,000,000,000 deficit, so I m surprised the lights are on today. In any event -- that was supposed to be funny, but I noticed -- there is nothing funny about energy in California anymore.

Dr. Alfred Cavallo. Dr. Cavallo received his Ph.D. in Plasma Physics from the University of Wisconsin, and worked in the area of fusion energy research at the Max Planek Institute in Germany and the French Atomic Energy Commissioner. He later worked on the Tokamak, if I ve said it right, fusion reactor at Princeton s Plasma Physics Laboratory, and after that he began working on radiation risk and wind energy at Princeton University s Center for Energy Environmental Studies, an agency we re very familiar with here. In recent years he s done work in the area of finite oil reserves to better understand how renewable energy systems can compete economically with fossil and nuclear technology.

Well, we re missing Kathryn Phillips, and I ll skip over that for now.

Mr. Mark Finely. Mr. Finley holds Economics degrees from the University of Michigan and Northwestern University, and a Finance degree from George Washington University. Mr. Finley is BP s Senior U.S. Economist based in Washington D.C. He analyzes U.S. Economy as well as domestic oil and natural gas markets in downstream and refining issues. He also covers OPEC issues, and contributes to analyses of global economic and energy matters performed by BP s London based economics team. Prior to joining BP, Mr. Finley served as an energy economist and Middle East analyst for the U.S. Government. He worked for Transworld Oil, a Bermuda based trading company.

And Mr. Blake Eskew. Mr. Eskew received a Bachelor s Degree in Chemical Engineering from the University of Texas and an MBA from Columbia University. Currently, Mr. Eskew is vice-president in the Houston Office of Purvin & Gertz, who sat at this table with us just last week, and

Purvin & Gertz did, that is, which provides strategic market and technical consulting services to energy industry clients worldwide. And Mr. Eskew s experience is focused on energy market analysis, strategic business analysis, and acquisition and project development support. He s previously worked in a number of planning, economic type of positions with Conoco and the Ethyl Corporation. And with that, I think Dr. Gautier is the first on the agenda.

DR. GAUTIER: Thank you, Jim. And I think we are in business. Can everybody hear me okay?

PRESIDING MEMBER BOYD: Let me take 30 seconds to explain to our panelists that the long mic here is the one that amplifies -- goes through the sound system here, and the small mic is the mic for the recording systems. So some people grab this and think it s going to amplify, but it just doesn t work. So --

DR. GAUTIER: I ll do my best. Well, good morning everyone. It s nice to be here. It is my privilege to work as one of the principle scientists on the USGS World Energy Project, and my invitation here today, I believe, is to tell you a little about what we ve been doing on that project and how some of the results of that work pertain to the questions before the Commission and the workshop at hand today.

I will be focusing mainly on oil. If I have a chance, if time permits in the next 45 minutes or so, I may say a few words about natural gas, but the focus will be principally on oil.

I d like to try to cover a number of themes. One is, I ll begin by giving a little bit of background about some of the terminology, the difference between resources and reserves and production, and I ll tell you a little bit about this assessment project of ours, how we went about it and what it means. I will -- I will describe our results with respect to undiscovered conventional resources. I ll talk briefly about growth of reserves in existing fields worldwide and here in the U.S. I ll summarize the overall results of our project. And then one of the subjects, I think, of particular interest to this workshop is this notion of the oil production peak. So I ll talk a little bit about that. And finally, some of my views with respect to where we are now, and some view to the future.

The factual information I m presenting here I think is true to the results of the project. You ll forgive me if occasional opinions and points of view slip in here that aren t necessarily the absolute policy of the United States Government, but I m going to try to give you the story as straight as I possibly can.

Okay. This project that we re working on focuses not on the entire -- not the entire energy base, but specifically on oil and gas, and in particular on growth of reserves in existing fields and estimates of undiscovered conventional resources. That means we do not talk about cumulative production. We really are not directly concerned with reserves, other than how they may grow, and we really don t directly address in this project the idea of non-conventional, or as we call them, continuous resources like tar sands and hydrates and tight gas sands and a whole host of other things. So it s a fairly narrowly defined project.

Well, as you know, if you look across the history of the 20th Century it s probably no exaggeration to say that the growth of economic influence and cultural influence in the United

States has gone hand in hand, one might say is linked closely to the growth in our consumption of fossil fuels, and especially the growth in the use of petroleum and the use of natural gas. Notice, though, that the use of coal is even, itself, at an all time high.

We -- As Jim mentioned, we are, indeed, prolific consumers of petroleum in the United States. We consume several times more than our nearest competitor here in terms of billion barrels of oil per year. You see that we vastly outstrip our next competitor, Japan, in terms of consumption. Down here in California, well, we would rank well up the list, above Italy and below Germany in terms of petroleum consumption if we were a country.

Surprisingly, at least, I guess, for me, if you look at the EIA data and you look at production of oil and oil petroleum fluid -- fuel -- liquids, including liquids associated with natural gas and plant liquids, that sort of thing, the United States, as of 2001, was the world s biggest producer of petroleum liquids. That surprised me. We re followed closely by Saudi Arabia and Russia. If you look at petroleum itself, crude oil, we are behind Saudi Arabia and Russia.

However, having said all that, we in the United States have been on a gentle but relentless downward trend in our production of oil and gas since we reached peak oil production in about 1970.

More tellingly, I think, to look at the state of the activities in the United States compared to much of the world, here I ve listed the average oil production per well. That is, average well production for some interesting countries. Compared to Saudi Arabia, where the average well produces more than 5,000 barrels of oil a day in the whole country of Saudi Arabia, I don t know, there is about 1,500 wells, here in the U.S., the average well produces less than 11 barrels per day and that s because it s that high because there are some enormous wells in the Gulf of Mexico and in Alaska. So, we have a zillion, that s a geological term, a zillion low productivity wells from which we produce all of this oil.

Here in California, my favorite oil field is called Midway Sunset. It s down in the southwest part of the San Joaquin Valley. In contrast, in Saudi Arabia, where there are about 1,500 wells in the entire country, Midway Sunset Oil Field itself, I was told just a week or two ago, has had more than 28,000 wells drilled in it. 28,000 wells.

I think it s important at this point, before I proceed with my talk, to try to make for you the -- this -- whenever there is a crucial distinction between resources and reserves. Resources are, indeed, arguably a geological phenomenon. The distribution of molecules of hydrocarbons in the Earth s crust. They are geologically interesting. You know, there is methane in the atmosphere of Jupiter. There is methane in cow intestines. There is methane all over the place. One could argue some of those are resources, but they re clearly, clearly not reserves.

Reserves, then, are that part of the resource base which is recoverable under existing economic and operation conditions. So it s a very, very tight definition. It means you have to have the technology in place and you have to have a market for it.

Here is where this intersection of economics and geology and technology look like near my home town in Southern California about 100 years ago. In the United States, in spite of that I just showed you this intense development and downward trend in productivity, you ll see that through time proved reserves in the U.S. have held pretty much steady hovering between eight and twelve years of production in proved reserves through the entire history of oil production.

You ll see that as cumulative production continues, that our reserves -- our proved reserves have held pretty much steady. That s because reserves are determined by technology and economics to carry a very large reserve -- to carry high reserve to production ratio, would be, in effect, to have assets that you weren t receiving any income from. So companies strive -- if they know what they re doing, they strive to keep reserves at just that part of the resource that they can produce from.

Let me mention, then, a little bit about our estimates of conventional undiscovered resources worldwide. On this plot we ve made a -- as a cumulative percentage we have taken ranked geologically based petroleum provences worldwide. So this would be like a geological basin from which oil and gas are produced, like the San Joaquin Basin, for example, in California, the Los Angeles Basin in California, or the North Sea, perhaps.

And then we cumulatively plot them here by size rank, and you ll see that when you get out to about the 100th provence or so, you account for more than 95 percent of all the produced and currently carried as reserves oil and gas in the world. On this plot the United States does not make it on the list until about number nine, when the U.S. Gulf Coast shows up. Northern Alaska, a place that we pay so much attention to in our political machinations, ranks at about number 20. The San Joaquin Basin would come in at about number 30 on a plot like this. The North Sea, between the U.K. and Scandinavia sits in here at about number eight. I would rank higher than anything we would have in the U.S.

Our project, then, focused on those 95 percent, those first 100 provences or so of the world that contain 95 percent or 96 percent of the world s oil, and we tried -- attempted to make an estimate of undiscovered oil and gas remaining in those provences. In addition, we through in a few other basins around the world that we kind of in a silly fashion call boutique provences. We put them in because they were of interest to us for one reason or the other of local significance. But by in large, we looked at the -- the petroleum bases of the world where production and development has already been intense.

Our analysis went on a provence by provence basis, so it s geologically defined. And on each of these provences, for example, the Neuquen Basin in Argentina, as an example, we looked at it from two points of view, from a geological point of view in which we attempted to look at the literature and talk to operators who know this place, and find out how the petroleum system works here, what are the traps, where the sources are, what are the migration pathways, what are the geological constraints on this place.

The second type of analysis we did looked at exploration history. We looked as the sizes of -- sizes and numbers of fields that have been found as a function of time and drilling. Using this combination of geological information and drilling statistical information, we attempted to estimate the range of possibilities for the numbers of undiscovered accumulations and their sizes. Numbers in the triangular distribution, maximum, minimum, and some central tenancy, the sizes were done based on assumption of a population which, as we called it, a truncated, shifted law of normal distribution. I m not even going to dwell on that.

These two populations were combined into a forecast of undiscovered resources for each petroleum system. And I m not going to talk about this any more in my talk, but I want to emphasize right here that everyone of these estimates is, indeed, problemistic. It carries a great deal of uncertainty. I will carry on just talking about mean values and median values, but understand, we re talking about unknown quantities here, and so, there is, indeed, a great deal of uncertainty associated with it. Yes, sir?

MR. ABELSON: Just one clarifying question.

DR. GAUTIER: Yes, sir.

PRESIDING MEMBER BOYD: Excuse me. You ll have to come to the mic if you want to be on the record.

MR. ABELSON: Thank you. My name is David Abelson. I m an attorney here at the Energy Commission. You re talking about undiscovered resources, and at the beginning you made the distinction between reserves and resources, resources simply being any hydrocarbon flying in the universe. The way you re using the term undiscovered resources at this point, how are you defining that?

DR. GAUTIER: Fair enough. What we re attempting to do here is estimate sizes and numbers of undiscovered conventionally recoverable oil and gas resources. That is, accumulations that if explored for and discovered would be developed as conventional resources, and, indeed, would be converted to reserves. So, very restricted to that part of the resource base, which if discovered developed would be conventionally recoverable as reserves. Thanks for the question. I should have mentioned that.

The second thing we did, and this was not the biggest part of project -- the biggest part of the project focused on these undiscovered resources. But the second thing we did is we took a first cut at thinking about the growth of reserves in existing fields worldwide. The observation is that through time it s very common, very, very common, I ll show you some data from this in a moment, for initial reports of field sizes to increase through time. That -- so reserve growth is the observed increase in reserve in fields over time.

We typically observed the initial estimates are conservative, and these conservative initial estimates are because of SEC reporting requirements, some corporate psychology, a number of factors. Their estimates are conservative because we haven t yet applied, perhaps, advanced technology in exploration, we haven t necessarily applied the most advanced drilling technology, and later on in the development in the field, additional production technologies are applied. And, of course, there are political and economic changes. All these things tend to cause reserves to change through time, and although they can go up and they can go down, by in large, they tend to increase through time.

Let me give you one example from my favorite provence in the U.S., the San Joaquin

Basin. And I would call your attention to the red symbols here, to begin with. And you see that we have cumulative recoverable oil up here on the left hand axis, and years time going across the bottom. So this, then, represents the discovery history of accumulations in the San Joaquin Basin, and we re just adding up the volumes as we go across.

So you see that early in the barrel there are -- early in the development history of the San Joaquin Basin between say 1900 and 1920 or so, we found a few very large fields very easily and very rapidly. And since that time the discoveries have sort of tailed off and approached relatively small value. So through time we re finding fewer and fewer and smaller and smaller, or at least smaller and smaller accumulations.

Now, I would like you to shift up to this black -- sort of black dots up here. Let me say one more word about the red dots. The red dots represent the data, probably as reported by the Division of Oil and Gas or some commercial data base, for the accumulations of California, of the San Joaquin Basin as reported in 1985.

So if you looked at the data base and

looked at the Discovery History of California fields in the San Joaquin Basin as of 1985, it would look like this. If we go back and make the same sort of plot for fields as of the year 2000, we see, well, we have added a couple of fields, perhaps two or three fields out here. Very small fields. A few million barrels. We ve added, perhaps, since 1985 to 2000, 15 years, we ve added a few million barrels through discover of new fields.

But look what s happened to the entire plot. It is translated from here to here. So we have discovered a few million barrels of oil by new field discoveries, but we have added something close to four billion barrels, four billion barrels to reserves in this old, worn out petroleum provence, through growth of reserves in the fields that were already discovered. It s a remarkable number.

And it isn t just in the U.S. Consider the giant oil fields of the world. These are the fields greater than 500,000,000 barrels worldwide. We looked at a set of data from Petroconsultants from 1981, then we looked at the same set of fields in 1996. So we have two looks here. What were the size of these fields in 1981? What were the size of the fields, these giant fields, in 1996? And then we plot them on here.

And if the field size, and by size I mean total cumulative production plus proved reserves, if that total number, that total, ultimate recoverable number didn t change, then it would plot -- then the field would be plotted right along the zero line here. If that total estimated ultimate recoverable number declined, then we would plot below the line here. If it increased, we d plot above the line.

The first field on here, the first one, is Greater Ghawar in the Kingdom of Saudi Arabia. The second field here with the spectacular collapse, is Burgan in Kuwait. This -- in all likelihood, this dramatic increase in the reserves in Burgan reflects the engineering practices of the Iraqi Army in about 1991. So, this represents damage done through the burning of the fields.

At any rate, you ll see that as you look across here, there are, indeed, a number of fields that shrank through time, but the vast majority of them -- the vast majority of them increased dramatically. And, indeed, over that 15 year period, we added something like 160,000,000,000 barrels of oil through growth of reserves and fields that already existed as of 1981.

This observed growth is observed to have occurred both in OPEC and in non-OPEC countries. Here we ve plotted it in little graphs by little bars by five year increments or four or five year increments. And you see that it is uniform. Some periods of time we see more growth than others, but growth is an important phenomenon in most places of the world at most times.

Just to briefly summarize, in the United States, reserve growth has accounted for more than 85 percent of all reserve additions in the U.S. over the last 15 years. No one has ever tried to make any sort of an estimate of reserve growth worldwide, and we took a first shot at it at a global level. And I need to emphasize that there is probably a great deal of uncertainty attached with the numbers that I m reporting here about reserve growth. So it isn t -- you know, it could be higher, it could be lower, but we think it s so important that we have to pay attention to it.

In our estimate, in our view, in our study, future reserve growth is probably as important as future discoveries of currently unknown fields. It s a very large number. We estimated future reserve growth of something like 690 or so billion barrels over the next 30 years. Natural gas, perhaps, on the order of 3,600 trillion cubic feet over the next 30 years or so.

Let me try to summarize briefly the results of our study. Here in the lefthand part of this diagram is our sort of grand summary chart for world oil. On here we have plotted -- this is as of our study, which used data as of 1996. So the data is a little out of date now. But at that time, these are the 1996 data in our resource study, we ve laid on top of one another here, cumulative production, proved reserves, our estimate of growth and reserves in existing fields, and then our estimate of undiscovered resources for the world.

We came up with a number here of around 3,000 billion barrels total, sum total, but let me remind you, and I know I told you this, but I just want to emphasize this, this is conventional oil, and this is oil that is there for accessible, in our view, with existing technology and existing scientific methods. It does not include unconventionals. Of that 3,000 billion, we think something like 76 -- more than 76 percent of it remains unproduced. Of that 3,000 billion we think something like -- likewise, something like 76 percent of it has already been discovered. That is, it has been produced. It currently carries reserves or we are going to see it as growth of reserves in existing fields.

Looking at gas, a little different story. If you report gas for comparison sake, we converted to barrels of oil equivalent using a thermal unit conversion just so we can compare volumes, if you will. In barrels of oil equivalent, we had about 2,500 billion barrels equivalent gas, which surprised us because from a geologists point of view there is a lot of reason to think that gas is a lot more abundant than oil.

Our guess is that this reflects probably conservative reporting from companies, very little interest from companies because gas is not really fungible. It s hard to move around. If you find it out in Siberia you can t sell it in California because it s very difficult to get here without some complex process. So we think it s generally under reported and conservatively viewed.

Nevertheless, with respect to gas, we some something like 88 percent of the conventional gas in the world is as yet remaining, and of that gas, perhaps two-thirds of it, of that total gas, 2,500 billion barrels equivalent, have been discovered.

Of course, it won t surprise you for me to tell you that these oil resources are not -- are by no means evenly distributed. Indeed, they are remarkably concentrated around the world, so it isn t as though they materialized out of the ether. They have to be found and developed and moved to the places where they re being used.

Our estimates of undiscovered, perhaps, not surprisingly, we found that most of the undiscovered oil probably remains in the Middle East, North Africa and the former Soviet Union. In the rest of the world, much of the -- there is a lot of undiscovered oil, but much of it is offshore.

The situation for gas is a little different. Most of the undiscovered -- most of the known, and indeed, undiscovered gas is in the countries of the former Soviet Union, although there is a lot of it in the Middle East and North

Africa, and then quite a bit of gas distributed across the rest of the world, must of it offshore.

Just a word about our estimates. I don t think it s -- you know, you want an independent estimate, so it isn t particularly good for people doing estimates to compare back and forth, but there was really no (inaudible) here. Here I ve just plotted a lot of -- I haven t plotted. Someone has plotted -- Jean Laherrere, actually, has plotted a number of estimates of world oil and gas over the last, I don t know, six decades or so. And you see that our estimates -- Up here in the most recent ones, our estimates are sort of in the middle of a widely spread field here for estimates of undiscovered oil and undiscovered gas.

Well, how have we done? I told you that this study was done for data as of 1996. So we had the interesting opportunity, since we had a more recent database, we went in and looked at what has happened between the period of 1996 and 2000. You say, well, okay, you guys claim to be able to predict this unknowable quantity. How did you do? It s a fair question.

So on this map I ve plotted the

locations of all the new fields that have been found that are larger than 200,000,000 barrels that were discovered during the period in 1996 to 2000. And we did pretty well. Most of the discoveries, indeed, happened in provences where we predicted it to happen, although there were some very interesting occurrences that were outside of places we did studies.

For example, there was a big field found here in Gaya. There were big discoveries off the U.K. in the -- west of Shetlands area. And then there was a basin here in Northern Africa. So there were a number of places where provences that were not part of our assessment have indeed resulted in discoveries. But it s -- anyway, it s a fun plot.

Okay. So I ve summarized for you a bit of that project work, and I would -- oh, I would say, while we re on this subject, that if you were interested in the details of this study, it s a four CD set, and I would be happy to provide that study to you. If you give me a card or send me an e-mail, I will have one mailed out to you and it will be there within a week -- a week or two. And seen as it s kind of fun, I d be happy to send it to you.

Well, one of the subjects in the invitation, or one of the subjects that was said to be of particular interest to this group was this notion of the peak of world oil production. There has been some discussion of that lately, and so I thought I would make a few comments about it from my point of you, from the U.S. -- I don t want to USGS point of view, although I think we re largely in agreement on this.

But one of the things, and I don t mean to be flip here, but one of the problems with dire consequences associated with predicting a peak in oil production is that these sorts of predictions have been made since the very earliest days of the oil industry. In 1885, the Pennsylvania State Geologist was warning people that they were about to run out of oil, and you better be ready for it. In 1919, the chief geologist of the USGS, and you know those guys are terrific, right, they -- he said that peak production will be passed within three years, and you re not going to be able to run your ships, and, you know, the end of the world is approaching.

So there have been predictions like this made on a regular basis for the last 125 years or so. But the argument goes like this. That we are seeing a downward trend in the size of accumulations being discovered. That we know with some reliability what the volumes of world s are -- of oil is in the world. I m sorry. And if you project current development and production, that we will, in short order, fairly short order, pass a point where demand will exceed supply and production and we will -- and because of the excess demand, we will go into a rather precipitous decline in not only production but in our economic viability and our infrastructure, and indeed, in our population. A prediction of very dire consequences, indeed.

The most dire prediction that I know of is posted on oilcrisis.com by R.C. Duncan, and he argues that we are living here at the latter part of the industrial age. If you plot oil -- oh, I m sorry -- energy availability per capita of the world population that we have gone through the spectacular peak, and that we have now passed that peak. We are on the sharp declining side, and we are facing, basically, the collapse of civilization and perhaps the collapse of the human population. You see here a sort of 70's looking guy stumbling off to the right with his stone tools facing oblivion, I presume. So a very, very dire prediction indeed.

These recent predictions of peaking have been based largely on the work of a geophysicist named M. King Hubbert. Hubbert was a brilliant and irracible geophysicist trained at the University of Chicago. He worked at Columbia from -- through the 30's and 40's, and he began developing a sort of logistic equations to analyze the U.S. workforce, interestingly enough. This was in the days of the depression. They observed that people were out of work and they were applying mathematics to that problem.

But when he moved to Shell, I don t know either around 1950 or approximately late 40's, he began applying these logistic equations to U.S. and world oil and gas -- world oil supply. He worked at Shell until, I don t know, late 60's or about 1970, then moved over the U.S. Geological Survey where he worked out the rest of the career -- of his career.

The idea is that if you have a finite resource that can be well defined, that it may go through a production cycle that increases significantly, passes through one or more, I might add, maxima, and then it declines back to something near zero again.

It s important to know, though, when you look at the Hubbert analysis, that a number of things are required for this sort of analytical approach. One is, you must have the system you re analyzing being very well-defined. You must know very precisely what it is you re talking about, meaning, say, if you re analyzing the U.S. oil production you ve got to be talking specifically about fields at a certain depth range in certain states using certain types of technology. You must be very specific. Very, very specific.

Next of all, you have to know that the market you re analyzing is closed to substitution. There is no substitute for the commodity that you re concerned with. You must know the ultimate volume. You must know very precisely what the recoverable ultimate volume is, and finally, you have to make the assumption that the production curve is symmetrical.

Let me just -- Let me -- I ve talked a little bit about the definition of the system, and you see that I regard as enormously complex problem worthy of a career s work. But let me talk about these next three items here, specifically. First being substitution. This is a plot of production of Pennsylvania hard coal, Pennsylvania Anthracite. Production of Pennsylvania hard coal really began back here about 1840 or so, and it increased dramatically until about 1920. And it s gone through, well, I guess you could say one major peak, and it s gone into significant decline until now Pennsylvania hard coal production is very, very low indeed. It has, at least superficially, the look of one of these Hubbert curves.

Well, this initial increase reflected people replacing the use of wood, and I don t know what they used, dung, I don t know. But they were replacing whatever was at hand with this remarkable hard coal, soft coal, perhaps, using hard coal in home heating. But since the 1920's, the use of hard coal has been replaced in home heating, largely by the use of fuel oil and natural gas. So this curve is a substitution curve. It has nothing to do with the geological abundance of Anthracite in Pennsylvania. It reflects production. There is still a great deal of Anthracite in Pennsylvania. It just isn t relevant.

The next question, is this an ultimately recoverable resource? This queue, as Hubbert would put it, does this ultimately recoverable resource consist of a number of things? It has to have cumulative production. The total proved reserves, we ve -- and cumulative production is a historical item. You can get that pretty closely. Proved reserves are a dicey business. They re reported differently by country, by company, through time. This is this thing we talked about early on, this intersection of geology and technology and economics.

You have to be able to know with considerable certainty about future growth of reserves in existing fields, or shrinkage, if you will, and you have to know what s going to be found in the future. All of these things must be known with considerable certainty to specify the ultimately recoverable resource.

And finally, you have to -- you have to be able to make an assumption of a symmetrical production curve. Indeed, I showed you a symmetrical production curve from Pennsylvania. It wasn t a Hubbert demand curve, but it had the shape like that. But Hubbert himself pointed out, this is a plot from his, that indeed, many commodities go through a multiple cycle curve and make a much more complex presentation of the simple symmetrical one. This, of course, is the -- green is production and red is cumulative production, and then that which is equal to the area under the curve in the Hubbert analysis.

What we have seen, in my experience, is that rather than the simple monotonic single peak production profile, what we see in many provences worldwide, for example, here in the San Joaquin Basin or in the North Sea, we see rising production and then we kind of bounce through a number of peaks. There are multiple maxima, and a rather gradual tailing off of production on a provence basis, sort of a plateau rather than a peak.

How am I doing for time, gentlemen? I know we started a little late.

PRESIDING MEMBER BOYD: You re fine.

DR. GAUTIER: Okay. Let me --

PRESIDING MEMBER BOYD: I d rather take

the time to hear it.

DR. GAUTIER: Okay, very good. Well, let me, then, try to shift yours a little bit and talk a little bit about where we are now with respect to oil and perhaps gas, and perhaps some views of the future.

There has been a remarkable transformation in the oil industry in recent years. Here we ve plotted well drilled and success ratios. We see that over the last, oh, 20 years or so, we ve seen a dramatic decline in the number of oil wells drilled. We ve seen some increase, or perhaps a leveling of gas wells drilled, and we ve seen a revolutionary improvement in the success ratio. That is, these companies -- these companies have become so good at identifying these accumulations and hitting them with a drill that it s absolutely -- it is absolutely remarkable.

At the same time, the costs of finding and developing new accumulations have been falling. I would argue that they ve leveled off recently, but they ve gone through a dramatic -- a dramatic decline. These companies, by the use of technology and science, have become very good.

Maybe we ll hear more of this later. They ve become very, very good at this.

Oil and gas reserves, with all of the uncertainties associated with that, have generally been increasing over the last 10 years or so. There is this big spike in world oil reserves very recently. This, though, is mostly from the Canadians now carrying heavy oils as proved reserves. And, remember, those are -- I call those really unconventional and really they re not quite what we re talking about here. So, you know, you should think of that, sort of, from your own final reference.

Proved reserves, same sort of things. Oil has increased significantly, but rather flat in the last 10 years or so, but modest increases. But what we ve seen is that for world oil we re now looking at reserves that are more than five times that were reported at the end of the Second World War. The proved reserves at the time of our study, the data we have from 1996 was the 2000 study, they were sitting, remember, at about 890 billion barrels of oil. Today they re sitting at about 1,100 billion barrels of oil as of 2001 for increase of 15 percent. If you look at Oil and

Gas Journal data and include those Canadian tar sands, which has been added to proved reserves, there has been 36 percent in reserves over this period of time.

We re currently consuming worldwide about 28,000,000,000 barrels of oil a year. Oil and gas discoveries have absolutely increased in the 90's, and indeed, in the United States they have even increased during the last five years.

The price is implicit in this discussion of supply. I know that the reason you re here, and the reason the Commission cares is not because of the geological -- the fascinating geological problems associated with the distribution of oil and rocks in the world. It probably has something to do with, what s the relationship between availability and price.

The price of oil is a wondrous thing, but it s not geological, at least it hasn t been up to now. So when I talk about the price, you know, very clearly I m talking about things about which I know almost nothing. But nevertheless, having said all that, I m just going to go right ahead and talk about it anyway.

There were these remarkable price spikes in the early days of the oil industry, but beginning about the time of the discovery of --

PRESIDING MEMBER BOYD: Could you (inaudible).

DR. GAUTIER: I m sorry. Yes, of course. These are just dollars per barrel, and the blue line represents year 2000 dollars, and the red line is dollars of the day, that is, yeah, nominal versus real. Okay?

PRESIDING MEMBER BOYD: What year starts?

DR. GAUTIER: And we begin back here about 1860 when Colonel Drake dug his well there at Titusville, Pennsylvania, and then we go out here to where we are just about today.

And you see that early on in the days of the Pennsylvania oil boom and shortly thereafter, there was this remarkable price volatility. Big discoveries were made worldwide and the price settled down. You can plot -- just about every plot on here, though, every spike on here has a political or an exploratory event associated with it.

There was quite a period of time when the price was really controlled by the Texas

Railroad Commission, and so we had this remarkable, and I might add, pleasant stability that went all the way up until our friends in OPEC decided they were going to just express themselves a little bit. And so now we ve had this spectacular price volatility since the early 70's, and each one of these spikes can be attached to a political or military event in a very remarkable way.

So we had a decline here down to about, you know, the early 1900's, great stability up to the early 70's, and now this great volatility with, I would argue a rationing up of the average price since the 1970's in real dollars.

Let me say a few words about natural gas, because it s not completely irrelevant here. In California in particular it s a big issue. Sometimes we talk about substitution for oil that might involved natural gas. Worldwide we ve seen dramatic increases in reserves in natural gas, huge increases in reserves, even though the companies are really rather conservative about it. Today worldwide there are more than 5,000 trillion cubic feet of gas in proved reserves, specifically in proved reserves, and these 5,000 trillion cubic feet of natural gas are chasing less than 90 trillion cubic feet of annual demand. So from a supply demand point of view, at a global level, there is a glut, an absolute glut of gas worldwide.

Indeed, one can make a fairly alarming case that most of the natural gas or most of the proved reserves in natural gas in the world are worth something very close to nothing. Indeed, there are places where, what do the economists call it, negative -- not negative project. Negative opportunity costs. That it would actually -- they are willing to spend money to get rid of gas.

Now if you go to Nigeria today, Shell, which is arguably one of just two or three or four of the world s most sophisticated companies and other operators as well are flaring huge volumes of gas to the atmosphere because they just -- they can t develop a market for it.

And, indeed, the problem is this. Here for fun I ve plotted the USGS provences worldwide, and I ve color coded them intensity of red proportional to the gas resource in that geological provence. So if it s intensely red it has like regular gas. If it s kind of a dull read it has less gas. I didn t plot the U.S. on here. But I plotted it on this interested NOAA image of the Earth at night.

Now the Earth at night shows, I think, the sort of energy consumption, sort of a proxy for maybe natural gas and oil and other usage, and, of course, the big consumers are here in Western Europe, in Japan, in the United States, and in California, including California, I might say.

And one of the things that strikes you immediately is that there is a discrepancy, a geographical discrepancy between where the gas is and where the consumers are. And unlike oil, which is totally fungible, you can move it by tankers readily, gas is a much more complex problem.

Here in the U.S. we are big time importers of natural gas. We import it from Canada. We import it from -- as LNG. We export some to Mexico and we export some as LNG, but mostly we import from Canada and a little bit of LNG. We have seen that our demand has been rising, but our production has not kept pace, and so imports have been increasing through time.

The gas applied issues, in contrast to the worldwide gas situation, the North American gas supply issues are very interesting. There are reduced estimates of gas resources in Canada, and indeed, Canada is probably -- may very well use natural gas to develop these heavy oil resources up there. So the idea of greatly increasing Canadian imports in the future, there is a question about that.

This Burgos Basin, just south of Texas and Mexico, there probably is not nearly as much of gas there as some people had hoped, and so exports to Mexico are increasing from the U.S. every year. So we have gas supply problems at both borders. Our U.S. production has been a bit -- has been a bit disappointing, and so we re seeing this remarkable price volatility.

The price volatility scares some investors and regulators off from developing pipelines to haul arctic gas down here. LNG facilities, you have to be able to put in a big investment to make it work. So there is a lot of reason, at least in the short time, I guess I d call it short to mid term gas supply, there are some real questions about that in spite of the worldwide glut.

Let me bring this to a close here with a couple of summary slides. We think the world looks like this, but if you add up oil and gas and natural gas liquids there is something close to 6,000 billion barrels of conventional oil and gas in the world that could be made available in the next 30 years or so. Of that 6,000 or so, there is something close to 5,000 billion barrels that are currently remaining as conventional resources. Of that, something like -- something more than two-thirds have already been discovered, and something like 30 percent of it is sitting in proved reserves. We ve produced about 17 percent of this whole total hydrocarbons, and we have an annual consumption of less than one percent.

If you, and I don t, but if you bought the idea that the USGS estimates are highly accurate, precise and that they represent all of the conventional oil that could ever be found, and you made a plot showing production, it would -- this is one model that came out of Stanford a year or two ago. It predicted an oil production peak shortly before 2,040 and a gas production peak shortly after 2,040.

But I would remind you that this USGS world assessment is not an assessment of ultimate recoverable. It does not include frontier areas. For example, most of the entire arctic was off this study. A lot of deep waters have not been explored. There are many politically inaccessible spots.

I told you about this very interesting phenomena of growth and reserves in existing fields. There are very -- man, many, many small accumulations just don t even appear on the radar screen worldwide, either from resource geologists or current production companies, and we haven t touched upon these enormous volumes of unconventional resources of heavy oil type gas hands, (inaudible) gas, hydrates worldwide. So we re not really talking about ultimate here.

My opinion, my personal opinion is that it is better not to think of resources as a finite number of items to be clicked off, after which you fall off a cliff, but rather a distribution -- we think of it as a pyramid in which we have higher quality but smaller volumes of resource towards the top. As you go down the pyramid, greater and greater volumes of lower quality, that is to say, increasingly expensive stuff.

What we ve seen through time, and I think that oil price plot shows this, what we ve seen is that as we ve been producing our way down into these more difficult complex otherwise more expensive resources, that the increasing costs have been offset or more than offset in many cases by improvements in technology and improvements in science.

And so, anyway, this is sort of the conceptual framework that I m carrying around as opposed to a cliff out there that we re going to fall off on. I believe that oil is a geological phenomenon. It is not infinite. It doesn t materialize out of the air. On the other hand, humans are a busy, active and inventive lot who have found clever ways to muddle through everything.

The data, to me, show there is no -- to me they show there is no imminent crisis from a global point of view. There are short term issues about gas supply in North America, and dictators here and strikes there, and there is a lot of things that control the price. But from a geological point of view, we are not facing an imminent catastrophe. Rather, we have -- we have some time to watch things develop.

If you d like some specific information on this, we have a website here, energy.cr.usgs.cov where most of this stuff is available, or if you would like to give me a card or send me an e-mail, I would be delighted to send out the whole four CD set and respond in any way you d like. I think that sums up my talk. If we have time for questions I d be happy to answer some.

PRESIDING MEMBER BOYD: We certainly have time for questions. Thank you, very much. That was extremely interesting. Any questions out there? Dave? You re the only one whose coffee has kicked in.

MR. ABELSON: Thank you. This question may not really go directly to what you were trying to present in your talk, but through the end of your talk you showed a graph where you gave the relationship of proven natural gas supplies to current annual demands, and basically said even with the data that gas is worth next to nothing, there is plenty of it there.

DR. GAUTIER: Globally. Globally.

MR. ABELSON: Yeah. What my question is, is given your information that s available about the oil, the conventional oil supplies, if you were to stick the equivalent demand number into that, how cushy are we on oil as opposed to gas?

DR. GAUTIER: How cushy are we? Oil, as I said, is highly concentrated in the world, and it is -- there is a much higher reserve -- I m sorry -- much lower reserves to production ratio for oil because for a number of reasons companies -- and some of my colleagues will probably be much better qualified to answer this question, but companies generally put in infrastructure in order to have production.

So whereas gas sometimes they stumble into it, they re looking for oil, they find gas, or, you know, who knows what happens. But so worldwide we have this oil concentrated in these countries around the Persian Gulf, in Venezuela, you have them in a few other places, and it is the situation now that if a few of these highly concentrated areas of oil supply have a disruption, like a politically oriented strike in

Venezuela, and say a, just pull something out of the air, a war in Iraq, or you know, a change of government in Iraq, because of the great concentration of oil in these countries, you can have an immediate hard ripple across the world economy.

My own view as a geologist is that probably long term, in spite of the numbers I showed you, gas is probably more abundant, considerably more abundant than oil just because it occurs from a wider range of rocks, it occurs in a wider range of settings.

But there seems to be quite a bit of oil in the world right now, and I think if you bother the countries and the companies who are most involved with big oil in the world, I think one of their major concerns is how to avoid a price collapse rather than how to avoid huge price spikes causing volatility, which is painful and they can get bad repercussions.

And I m sure they d rather have consistent prices, but very low prices really scare off investors, and these projects these days require huge amounts of capital, and so when the prices are volatile, then there is a great reluctance to be involved in investments.

PRESIDING MEMBER BOYD: Doctor, your data about the U.S., and not too -- on natural gas, and you re not too optimistic view of the future, is that -- do I infer that the U.S. s natural gas future is predominately LNG oriented?

DR. GAUTIER: We have been seeing big increases in demand in gas in North America, and there are projections and plans that you get from many places where they actually want to be using natural gas in preference to coal or oil. And so the question is, where might that gas come from? If, indeed, demand were to rise dramatically and be met, where would that gas come from?

My own view is that out of conventional production in the United States, at least in the lower 48 states, it will be exceedingly difficult to meet that demand out of that production without huge environmental consequences like in the water associated with deep water gas development, for example.

There is a great deal of gas sitting in the arctic. The Prudhoe Bay gas -- the Prudhoe Bay Field, for example, has, I don t know, 30 or 35 trillion cubic feet of gas sitting there. It s essentially free, but you have to have a pipeline. There is a lot of gas up there. It s probably 100 trillion cubic feet of gas in Northern Alaska. There is a lot of gas in the McKenzie Delta in Northern Canada, but they require pipelines.

So pipes and LNG is probably the mid to long term where gas is going to have to come from. That technology is not here now, and so in the meantime we are flailing about facing price volatility.

PRESIDING MEMBER BOYD: The nation of the State of California seems particularly concerned that we never had coal, we drove oil out for quality reasons, and we re creating a heavier and heavier demand on gas. In today s economy I don t see people chewing up to put the money in for pipelines to bring it safe from the Rocky Mountains to California, which seems like a logical but not happening event, etcetera, etcetera. So we re kind of worried where our future gas is going to come from.

DR. GAUTIER: Yes, indeed.

PRESIDING MEMBER BOYD: Any other questions? Well, thank you, very much.

DR. GAUTIER: It was my pleasure.

PRESIDING MEMBER BOYD: It was very intriguing. Dr. Smith, you re next up. Kathryn Phillips, I see you hiding in the audience. You have a chair and a name tag up here. Please join us.

DR. SMITH: Hello, ladies and gentlemen. I m pleased to be speaking to you today. My talk is entitled World Oil Resources and Peak Oil Production, and you probably think that sounds very similar to what you ve just heard before, but actually, I m talking from a somewhat different angle than Don. Actually, you ll find I disagree with him on many points, which may create some discussion at the end.

So I will start by talking to you about what my presentation involves. There is four aspects to this presentation. Some of them will be, actually, from a very similar format to what Don has just done.

Firstly, I want to talk to you about resources, reserves, and especially peaking. Then I m going to go and talk to you a little bit about regional and global production forecast that my company has prepared. Then I want to discuss with you about U.S. import position for oil and, to a lesser extent, gas. And finally, give you my thoughts on global depletion and what the future holds for the globe.

Firstly, I also want to give you a bit of a talk about definition as I think this is where we agree. Resources, the total amount of oil, or any resource, but in this case oil and gas, in place in the world, there is a simple term. Just accept it as that. But more important, recoverable resources, which is the part that can be recovered with available technology and economics, and that can be available if technology comes in the future or the present day. And reserves are the volumes which are discovered and recoverable at this present day.

So I ve got four terms here which I will be talking -- mentioning quite often in this presentation. Human production, that s reserves already produced, remaining reserves, there are those discovered reserves that will eventually produce but have not yet been, yet to find resources or recoverable resources that will be discovered in the future, which is a number which I ll talk to you about later, and finally, total cumulative, which is my term for all reserves that have and will be produced in the foreseeable future. Again, I don t include the Canadian oil sands, the very specialized unconventional resources that have different economic production that oil and gas have.

So if it s all clear on these terms, why is there any uncertainty in global reserves and resources? Well, there is many reasons. Firstly, there is a series which I call ambiguity. There is a lot of ambiguity in everything we hear about, numbers.

For a start, we actually know global standard definitions, although the USGS and myself agree, that if you went to Russia and looked at their definitions of what there is, you d find a completely different set of numbers and a completely different idea of what their volumes are in terms of reserves.

Secondly, the treatment of unconventional sources varies, which has been touched upon already. For example, some people include, some people exclude or with the different economics. Mined oil sands, and also in Venezuela, another important area for mined oil sands, natural gas liquids and gas to liquids purchases, such as LNG and other more modern techniques.

Thirdly, there is seriously time element to reserves. The word peaking, really, has only come into use the last few years. And to me, the production peak is vastly more important than the actual reserve numbers which it applies to. And ignoring the time that it first becomes under the discovery, what s been discovered in the past, this term reserves growth, which is a term I d like to talk to you about later as well with a different idea.

And secondly, knowing the time elements of productive, particularly reserves production ratios, which are -- tend to not give a true picture of how much production we have left, only how much reserves we have left.

And finally, ignoring what certainly the estimates are in themselves technically uncertain, very technically uncertain, and all the estimates that you ll hear today will be uncertain from myself included. And in terms, proven, probable and possible, which are terms used by the oil industry, merely confuse this issue because they are volumes of deception and not actual real volumes. And secondly, there is also uncertainty because of bias. There is a lot of bias in the way numbers are presented. And, obviously, we would all to feel we re not biased, and I think I m totally unbiased, but probably other people might disagree with that.

Firstly, geologists. Geologists are terribly biased when it comes to analyzing reserves because geologists like to think they re optimistic. All the companies I ve worked for, geologists always say they re optimistic and they get good points and get better pay wise if they re optimistic. Nobody wants a pessimist.

The trouble with optimism, the truth is that realism would actually give a different result, and normally less than what the geologists have said. So that s a geological bias which occurs, in my experience, everywhere. Secondly, the oil industry itself may under report reserves for regulatory reasons. This is particularly appropriate in the U.S. where the Stock Exchange Commission enforce strict rules of under reporting, which has been talked about earlier.

The industry also over reports. They do

this to maximize value. They clearly -- if they can say they ve got so much oil then it will maximize value. This might not happen so much in the appropriately regulated large oil companies, but certainly overseas in Russian companies and various companies in the world, the oil industry does tend to over report reserves.

Also, governments, they have to report too, and they do this for promotional reasons. They don t want any college people to come and explore in their country, so they give presentations putting a lot of spin on their prospects.

And both governments and industries fail to update their reserves, so we never really know what the true picture is of what s been happening in the short term past. And because of all this, public data sources, mostly taken from the Oil and Gas Journal, World Oil Magazine, and oil industry databases including the BP Petroleum Review, which is used a lot by companies, which is actually taken directly from Oil and Gas Journal. They all give different numbers, and this is obviously going to lead to a lot of confusion.

And just to give an example of how

numbers can get biased, this is just a plot of reserves numbers in the Middle East between 1982 and 1997. And we see in 1987, particularly, there was a massive growth in reserves, billions of gallons of oil. It averaged out where most of the fed numbers doubled, and this is purely a political thing.

They doubled not because of any real growth in their volumes of reserves. They doubles because they were scrambling for quotas at the time. All prices were dropping. They were developing quotas, and they need to convince the rest of them that they had lower volume so they could produce a higher rate.

And so they scrambled to produce. Saudi Arabia did it a couple years later because it took longer for them to get on board with this system all on their own for several years. And it s interesting to note, the neutral zone, which is the area split between Kuwait and Saudi Arabia, had no change in their reserves because the neutral zone, obviously if Kuwait decided to do it, Saudi Arabia might spot it, so there was no exaggeration of reserves there.

And in this plot of reporting remaining

reserves from 1980 to 2002, billions of barrels, we see that scramble for quota. But upper line, it s the total reports of remaining reserves in the world and the last solid green is just for Middle East OPEC.

And this massive increase in reserves was nothing to do with how many -- how much was actually found, purely to do with the scramble for quota. And as was already mentioned, the same thing happened last year when Canadian oil sand production reserves was included.

So this confuses everybody. That s just one example, but there are many others. But despite all this, there is general agreement on the total cumulative reserves. The consensus of past estimates, excluding mined oil resources, has been approximately 2,000 to 3,000 billion barrels of oil with USGS on the upper limits of that. But you used around 990 billion barrels up to now.

Gas is uncertain. Perhaps 2,000 to 2,500 billion barrels, which matches, roughly what the USGS said. And we ve marketed at just 480 billion barrels. I say marked it, but probably we flared approximately that much again, but that s not included in the totals here.

And these estimates are made by experts, including all the major oil companies. So I plotted here various estimates since 1950. I think Don showed a similar plot. And over the last decade there hasn t been much change. So I think a volume between 2,000 and 3,000, something like 2,500 billion is a reasonable number to take as total oil reserves available given to productions on there and remaining reserves plus you have to find the integral between the two lines.

And it s not -- it s hardly surprising that we do really have a fairly good handle on total global oil reserves because of the giant fields. The giant fields contain approximately 65 percent of all cum s of production, plus remaining reserves in the world. Now there is about 100 giant fields in the world. There is about 7,000 or 8,000 fields in total. So this very tiny percentage of fields contains 65 percent is quite a significant thing.

And these fields, also unsurprisingly, were discovered fairly early on in the history of the oil industry because they are fairly easy to find because of being so large. And we see obvious peaks for U.S. had it s giant field picked before 1930. Then Buran and Kirkuk signed, and Iran was discovered in the 40's. Ghawar and Romashkina, Romashkina is a Russian oil field discovered in the late 40's, and massive line of discovered giant fields through the 50's and 60's starting with onshore and then offshore fields.

There has been a slight peak in the last few years. This is special case of deep water oil, which I ll talk about a little later. A couple of fields, one in the Caspian Sea, which wasn t explored because of Russian inability to explore in deeper waters, the Kashagan Field, and Azagedan, which is a giant oil field discovered on the border between Iran and Iraq, which has been known about for about 50 years but wasn t drilled because of its location.

So my numbers that I use here are cumulative production, 990 billion barrels, just for your information. Remaining reserves, 104. Cumulative plus remaining 1994. I mean, those numbers are not precise, and the fact that they go down to not quite a decimal place, but down to a four at the end it a bit disconcerting. It should be really rounded, but these are the numbers used.

And yet to find resources of 217, which is significantly lower than the USGS, but it is a number which is generally held to be a reasonable number by most of the oil companies. I know certainly BP have numbers very similar to that for yet to find resources. Giving a total cumulative number of 2264, oil to be produced, 990, and yet to produce, about 1274. And production in 2002 was about 27 billion barrels.

So looking in percentage terms, we produced 46 percent of our oil. We have remaining reserves of about 43 percent and yet to find, 11 percent. And in terms of gas, which I ve not talked about so much here, is -- I only have preliminary analysis for gas. We produced 20 percent. We have remaining at 45 percent and yet to find, 35.

So we ve got a lot of oil left. I mean, there is no question that we will ever run out of oil, as many people look at the pessimists and say, oh, you keep saying we re going to run out of oil. We re not going to run out of oil, because what really matters is that oil cannot be instantaneously be bought on stream. New oil takes time. It takes five to 10 years to get, especially the difficult (inaudible) OPEC at the moment, it takes five to ten years to get on stream, certainly the bigger fields.

And because of this there will come a year, because of the way oil fields are developed, there will come a year where the production rate can right no longer, even though there is a lot more oil left to be produced, and this is a production peak, which he mentioned, and I want to mention a little bit too.

When we talk about production peak. It s actually been told, it was first described by the U.S. citizen M.K. Hubbert in 1956. And when he said the production from a group of fields in sedimentary basins peaks long before supply is exhausted, and that has been proven many times over.

A peak occurs when around half -- it s very general. Around half is between 40 and 60 percent. When around half total reserves have been produced. And once past, decline of large early fields, which obviously are the big fields that were discovered first, because they re easiest to find, cannot be compensated by new output from smaller later fields, and or by improved recovery. And I d like to talk about that later too.

So the peak date, the date in which we reach this peak is usually unaffected by technology or fields that remain to be found. It may sound a bit of a sweeping statement, but there is 99 countries in the world that produce oil, have produced oil or potentially will produce oil in the future. And of these 99 countries, I wonder if anybody realizes how many of them are actually probably already, maybe you think four or perhaps 10 to 15 have passed peak. Maybe 25 countries out of 99.

Well the actual fact that of 99 potential actual participating countries in the world, 60 countries already are at or past peak. And a further 12, including the U.K. and Norway, are very near their peak. And I d like to give you some examples of these countries. Firstly, Cameroon is (inaudible) is produced in West Africa. It peaked in around 1985 and has been declining ever since. This is a plot showing year versus barrels of oil per day. All the plots plotted against barrels of oil per day.

And if you look at the discovery profile of Cameroon, it s pretty obvious why it s declining. We see that discovery of oil in Cameroon, which is plotted as these yellow bars, occurred about 20 years before -- the main discoveries occurred about 20 years before the peak occurred, and there have been few discoveries in the last few years, and they ve all been small. And that s -- of course, there is always more oil to be found, or certainly more fuels will be found in Cameroon, but they will be small fields, unable to compensate for large fields found early in its history.

Now, for example, Austria. Austria, a modest producer in Europe, peaked back in 1950, and it s been declining ever since despite enormous attempts at recovery to improve and apply all the latest technology. Again, the discovery profile matches the production profile. The major discoveries were made earlier in history, including the Matson Field, which is a significant field in Austria, and since then, just a few more discoveries.

Now a bigger producer in North Africa and Egypt, that peaked at around 1990 and has been declining. And if you look at the same discovery profile, we see Egypt had two major areas of production, the Gulf of Suez, which was discovered fairly early on, and the main discoveries occurred in the mid 60's, and then the Western Desert, which was discovered -- began to produce in the late 70's and peaked, somewhere in the early 80's and peaked about 1980.

And finally, as an example, Indonesia, a much more important producer, certainly in the past. And we see just a slight different profile in that we got a lot of ups and downs at the top. And this is largely because during the 80's Indonesia was subject to OPEC production restrictions, restricted output. It is still subject to OPEC s production restrictions, but it s no longer restricted output because it can t. It s producing, flat out, is declining. Even though it has a quota, it can hardly meet it s quota.

And, clearly, the discovery profile in these also shows a similar format with a peak onshore discoveries around the 40's to 50's, and a peak in offshore discoveries around the 70's, the mid 70's, and have been in decline ever since. Some more recently around 2000, there have been a few reasonably large finds, and this is because of the impact of some deep water discoveries in Indonesia.

So the discovery profile is a signal to what might happen. Discovery seems to peak around 20 to 30 years prior to a production peak in the countries that have passed peak, which I say is well over 50 percent, all the countries in the world. And it doesn t directly apply geologically, because, of course, countries comprise a number of different -- may have comprised a number of different policies, but it is a general indication. It would be much more -- it s better to break it down into provences to get more accurate figures.

Offshore areas and those developed with newer technologies peak sooner. If you look at the offshore regions, they peak sooner because of the application of new technology is a faster development system, sort of, put in place, and more certainty is required before you can put the investment into offshore.

As with production restrictions, that is largely OPEC countries, but a few other countries too, they peak later. I ll show you Indonesia, and I ll show you some others later. So production peaks are broadly predictable by empirical methods, using this discovery peak, and the estimated total cumulative, and considering geotechnical political factors, ally to the current depletion rate in the country.

And so I give an example in countries that are just near peak, and we see that Norway, for example, it s major discovery events occurred way back in the 70's early 80's, and hence, it has just now started to decline. The Norwegians have published on their website a plot showing exactly what is happening, what I ve shown here, my interpretation here. Norway is about to decline.

U.K. too. U.K. reached it s peak in 1999 and has been declining ever since, and it s accepted by the U.K. Government, although not particularly announced because they want to promote confidence coming into the North Sea. That decline will continue. The production will continue to decline from the U.K. Russia, another case, most vast amount of discoveries occurred in the 60's and 70's in West Siberia. There was a dramatic drop off in the early 90's because of a former communism, and production is picking up again. By looking at the volumes and the discovery peak, it seems very unlikely that Russia will ever attain the heights they did in the past, and I envision a production peak in Russia of around 210 to 215.

The Asia-Pacific is a region -- see, as you get into the bigger regions you get much more numbers in as you get to the greater number of regions, so you get more. The statistics become more valid. And you see quite clearly that the discover peak and the production forecast, and I think most of the Asia-Pacific countries accept this as a potential future for their production.

Europe too. Europe is past peak, and I don t believe we need to talk more about that. It clearly shows the same.

So adding up all the countries and all these analyses together, in my opinion, my analysis, we have a series of potential peak years, which are entirely dependent on global demand. And if global demand is flat from now, I envision a peak year in 2020. Now this could be plus or minus five years either way, but it is there. I mean, clearly, the data is not sufficient to be precise, but it is -- in my view, 2020 is around about when it s going to occur. Production (inaudible) remain at present day about 74 million barrels per day, plus this doesn t include the Canadian and Venezuelan heavy oil production.

A demand that is one percent of global demand growth, then peak year falls around 2016 at 85 million barrels per day. A two percent demand growth is at 2012, around 90 million barrels a day. A three percent, 2008, also 90 million barrels a day. Now, the IEA, the International Energy Agency, are predicting something like 120 million barrels a day demand by 2020. Well, in my view this will never be achieved. It is impossible to achieve that sort of production rate with using the conventional resources I ve been talking about here.

So just to show what potential demand might be, this is an analysis of annual percentage oil supply changes since 1980. It plots the percentage supply increase or decrease in each year since 1930. Between about 1930 to 40, supply increased about three to five percent a year, and this is pre-World War. In World War II and post-war, there was quite a big change in supply, but always increasing.

Then in the big growth years of the 60's and 70's we were seeing seven to ten percent demand growth, which affects supply growth because they re almost linked. Then after from 97 to when OPEC started to exert control, we had the first oil shock and the second oil shock, and you see demand drop dramatically. And, of course, as did economic growth at the time. Then in the boom years of the 90's we re seeing between naught and three percent increase in supply, and the so called third oil shock, see a decline in demand again.

So in my view, for economic growth to occur we need at least one percent global demand increase. It s not evenly spread around the world, and I imagine U.S., you re slightly less because we re substitutes. But in China and India, certainly, we get at least one percent global demand if we want economic growth. If we re quite happy to muddle or have oil shocks as has occurred before, then they re fine, but if you want economic growth we need at least one percent.

So putting it altogether, this is just a plot showing these things. OPEC oil, I brought it in orange, non-OPEC oil in the light green, deep water oil, you see, doesn t have a great impact on the picture, and oil sands, which is the Canadian stuff, and Venezuela, and then refinery gain is a little sliver you get at the top.

So in around 2016, assuming at one percent, which this plot shows, there is going to be some sort of liquids gap, and this will have to be filled by substitutes. Now, certainly, gas is the most obvious substitute, compressed natural gas, perhaps, in transport. Certainly LNG for power generation. Fischer Tropsch s gas to liquids systems, which is converting gases into liquids to substitute for oil for the internal combustion engine. Biomass, certainly, and other replacement strategies you can think of. Also, clearly, my view, we would not be able to fill that gap with those alternatives, so we will have to reduce demand for energy efficiency and energy conservation, in particular.

And you may argue, well, the Middle East is going to solve all these problems, but I just wanted to show you a few countries in the Middle East on the same plots just to show that the discovery profiles are the same there, too, it s just their production profiles are different because they have been restricting production and conserving oil for so long in Iraq, forced conservation albeit.

The major fields in Iraq were discovered -- well, Kirkuk, the largest field was discovered in 1927. By then, major discovery period in the 50's and 60's and the 70's and 80's, which matches most of the older countries in the world, with this big decline in output in the 80's and 90's. and I plotted it on a little curve just to show what perhaps would have happened if Iraq hadn t become independent and still been controlled by European and American oil companies. And if that s the case, Iraq would probably have been pretty well at peak right now. And, of course, oil prices would have been lower.

The same thing is true for Iran. Really, pretty well, the same thing applies. I mentioned Azagedan as a special case giant field, which has been known about for 50 years but not drilled because of its location.

I list all these plots for the forecast plots, they re all based on a one percent demand. So it assumes that Iran, Iraq, and the next plot, Saudi Arabia with straight production from now up until the time where they don t have to restrict it anymore because oil prices are going to go up anyway. So you can see from these plots that Saudi is restricting production over, perhaps, the next five or six years. And they re starting to grow output, if they can.

And so it suggests that over the next five or six years there will be a glut of oil, and this is why people are loathe to accept that perhaps there will be a potential problem because we -- because there will be a glut of oil until there isn t, essentially.

And this is plotting all the global oil discoveries together, and I ve put on there a dotted line which gives approximate plot of what may have happened if OPEC had never existed and hadn t conserved oil. And you see we would have peaked already and we d be facing this potential decline already. And, surprisingly, enough of that plot actually matches pretty well what happened, say, in the 50's, that green dotted line, because as has been said earlier, Hubbert didn t consider potential substitutes and he didn t consider political circumstances, which change the shape of our curve.

So what about technology? There is other -- there is things that people say. Oh, we can solve this problem with technology. But technology, I don t think, is going to have a great impact on this. I mean, really, the figures speak for themselves. It s not having impact, because the discovery peaks have occurred many years ago.

Exploration technology certainly shows all is, but what s more important, it also shows what it isn t. And that is crucial, because what exploration technology and new exploration technology has done in the last 20 years is given much better estimates of remaining reserves and yet to find resources because of 3D seismic imaging in particular. And so exploration technology doesn t actually find reserves. It helps define them better. It doesn t change the actual volume.

New engineering technology, what about that? Well it certainly allows development of fields faster and cheaper. As we see in prices have declined, development costs have declined. Despite the fact that we re exploiting more and more difficult fields, development costs are still declining. So new engineering technology allows development of fields faster and cheaper. It also keeps production rates higher for longer, but in doing so it speeds depletion. So what engineering technology is actually doing, it is speeding depletion. It is not creating more oil.

Some technology, like exploitation of deep waters, for example, is clearly new. But -- and that is a special case, but if you can think of other ideas for what engineering can do, fine, but I can t think of other ideas. So actually, technology has a limited impact on the total cumulative reserves that are available to the world. All it does is speeds depletion.

And now this term, reserves growth. Peter Davies of BP, the chief of congress of BP in 96 said that, Over the last 20 years the world has added 77 barrels of new oil to reserves for every barrel consumed. Well, personally, I don t believe in reserves growth. Some fields go up, yes, and some fields go down, but I think reserves growth as a term is an illusion. Revisions in oil and field sizes are usually -- they re not always but usually in reporting and not in reservoir because of these terms, proven, probable and possible. Report of field sizes change with better knowledge, and they change because of government regulations.

So reserves and resources used for analysis of peaking must be most likely reserves. They mustn t be the numbers which you see accomplished as proven reserves, for example. So revisions are statistically neutral. Revisions must be backdated to the discovery date to really look at the genuine trend.

Just to give a little example of why reserves change, and this has nothing to do with the Stock Exchange and oil companies being forced to do this. This is just what happens in nearly every field that is developed. When you ve got a prospect, this is a plot of reserves versus years since the field was identified. And you ve got a prospect that may be determined to be 130 million barrels large. And when it s discovered they normally reduce it size because it s all just for being optimistic, and evaluated, it gets reduced in size again.

When you get to development planning it is reduced quite dramatically because you need the confidence to put in a development, so you tend to go for a conservative number just to be sure that you re spending your money wisely. If you put your money into a field that actually reduces in size, then you kind of look pretty silly and lose your job.

Over time development really occurs, and then you get performance to arrive at determination of what s in that field, and the field size goes up. So reserves growth is not a true growth. All it is is coming back to a number you first thought of.

And which brings me on to the U.S. I haven t shown you any plots of the U.S. because reserves growth in the U.S. is a particularly -- occurs more than anywhere else in the world. And if you look at discovery peaks and the production plot, you see it s very different from the rest of the countries I showed because they pretty well match.

And, also, you see they don t change for many years with the number of discoveries. This is because of the strong Stock Exchange rules in the U.S., which restricts companies from announcing reserves if they re not totally sure.

And I think this is a powerful argument to show how reserve growth -- how the U.S. situation is somewhat different from many countries in the western world.

The same thing would happen in the U.K. if the U.K. was an onshore provence, but it is an offshore provence, and offshore you have to be much more precise in your evaluation because you have to put in so much costs before you can develop. So you tend to -- you tend to err on the larger side in the offshore situation.

So that s reserves growth. What about deep waters? Deep waters is being put forth as this panacea for the future of oil production. Well, certainly, there are deep waters located in West Africa, particularly in Angola and Nigeria, and the Gulf of Mexico, of course, and Brazil, where it s been producing for many years, and small areas in Norway, and Australia.

And these deep waters are now critical for non-OPEC production limits, but unfortunately, deep waters may only achieve around 10 percent of global output at peak, which is not a vast amount. And this is a plot of what I see deep waters doing over the future, peaking around 2020, about 10 percent of global production, with the majority coming from Africa, Angola and Nigeria, and from U.S. Gulf of Mexico.

And finally, what about housed oil recovery and proven recovery from existing fields? Well, around 96 percent of all oil is now produced from conventional recovery systems with an average recovery factor of around 40 percent, and this is for natural drive, water flooding, and gas re-injection systems. The rest comes from housed oil recovery, especially heavy oil fields. Now over time a housed oil recovery will increase recovery, but it applies only to certain reservoirs in the world. I think it usually just slows decline.

So there are only a few EOR projects for a reason. There certainly is no conceivable way how EOR could vastly improve recovery rates in the big fields in China, in Russia, many of the big fields in Saudi Arabia, because wells -- really wells are an EOR system. You drill more wells you get more oil out. In China, for example, in Russia, they ve drilled thousands and thousands of wells.

So to show just a little example, Germany has been struggling with EOR for years, and has not been able to recover from that peak in 60's. And it s even that little up peak in the 80's was due to their one offshore oil field discovered in 1981.

So what about technology in the USA? Production has been falling since 1971 in the USA, as we know, and this is despite the best equipment in the world you have. You ve got the best, largest infrastructure. You ve got the most money, more than anybody else, and you have the biggest incentive. You ve got stable governments, rising imports, large areas, few onshore planning rules, perhaps not in California but in the rest of the U.S.

And now a new -- even new exploration areas have appeared in the U.S. in Alaska and in the Gulf of Mexico deep water. But still, you haven t been able to recover from that decline. So in my view, once you ve passed peak, that s it. You re never going to get back to levels you were before, and 60 countries are already past peak.

And that s the plot of the U.S. I ve plotted all natural gas liquids. Alaska, you see Alaska in light green, had improved production for a few years. Government is going to improve production but is certainly not going to recover the peak from 1970, and I d even put a little bit in for the -- in Alaska down at the bottom there, which you can see is not actually a vast amount relative to total U.S. production in the past.

So in North America here we see you ve produced 22 percent of your oil. Middle East up to about 25 percent of its oil -- total oil in the worlds that s being produced, at least 25 percent. But you (inaudible) about nine percent. So North America is clearly in a difficult position, and actually about 48 percent will come from the Middle East in the future.

And you can see how the oil production shift has fallen off. For North America it goes up a bit from 2025 to 2050 because of the impact of the Canadian oil sands where production is inexorably going to increase. And we can see the share from the Middle East, again, this is at one percent potential demand, increases quite dramatically from around 2010, and, of course, you re importing around 12,000 barrels of oil per day right now.

For gas, I ve got a preliminary analysis of gas. I m not going to talk about gas in any great detail. In my view you ve got a few years of flat production. The impact of the Gulf of Mexico gas will help, but then as gas -- the gas reservoirs are produced a different way from oil. They have much harder accompanying factors, and because of a pipeline system they tend to produce flat for many years and then suddenly decline. Gas fields very fast rapidly decline. And so the decline rates for gas is greater.

And although Alaska has a lot of gas, it s not going to have a vast impact on the general decline. As you see, I put in -- the darker pink you see is Prudhoe Bay and the rest of Alaska, and the lighter pink is potential gas from other areas.

And in terms of gas, North America has produced 44 percent of the world s gas, but only has about 10 percent left with the Middle East and the former Soviet Union clearly holding the large share. And it s dramatic decline in the North American gas production share from being the only country using gas in the 20's down to a very small percentage of the Middle East and the former Soviet Union having to provide the gas for the world. And, of course, the (inaudible) for gas is also not too healthy for the U.S. and expected to increase.

So what happens, then, if everything carries on as it is with business as usual? If the optimists are accepted and we ve got oil to 2040 or whatever, well, in my model what happens is that -- well, we can see around 74 million barrels a day at a one percent demand growth in 10 years, the world will be consuming around 86 million barrels per day. After 20 years at the same rate, one percent demand growth, we wish to consume around 95 million barrels per day. So this is a very modest amount of growth relative to what the IEA has been talking about.

But in 20 years in this analysis, and I m certainly am not alone in this analysis. I know not all companies have the same analysis. The world will be past peak and will only be able to produce around 75 million barrels per day. We ll have a lot of oil left. There will be no problem with the amount of oil, but it s just the speed at which it can be produced that s the key, the time element of production.

Now in terms of the U.S., the U.S. currently imports 60 percent of global oil, about

12 million barrels per day. In 10 years they ll need to import just about 17 percent. So it looks like not too bad, but this will 14.5 million barrels a day. But in 20 years you will need to import 24 percent of global production just to maintain one percent demand. Twenty-four percent is a huge amount of global oil, and I think if you need that much there is going to be a significant crunch. This is just one percent demand.

So where is it going to all come from? That s the question. Well, certainly, Africa has growing production. The gas is in red. The oil is in green. I m just going to talk about oil here. A peak of around 11 thousand -- 11 million barrels a day at around 2010 to 2015 I see in Africa, largely from growth in deep waters in Angola and Nigeria.

Same for South America. I see a peak of around 2015 to 2020, mostly this is controlled by Venezuela, and it s flat early on because Venezuela are restricting production because they have to because of -- in part because of their strike. And the former Soviet Union, producing around -- commonly producing around eight million barrels a day, potentially can produce around 11 million barrels per day peaking around 2010.

Of course, the Middle East is going to produce a large share. I see the Middle East can perhaps manage around 38 million barrels a day, which is still a vast increase to what it s doing now, and it would require huge investments in the Middle East to reach that level in the time allowed. It certainly can reach it, but it s -- but perhaps, I think, perhaps I m being a little optimistic. Perhaps that curve would be not as steep and the peak would be later. But, of course, that will make the peak in the globe earlier because we won t be able to manage the output what s needed.

So in business as usual, if all those regions are exporting, but USA is the only importer, of course, the Asian-Pacific is at peak for oil now, the second biggest importer in this area, Europe is also at peak, it s peaked in both oil and gas, and many developing countries in other regions will, of course, want to use more oil and gas as well.

Just to show you why this is clearly the case, this is a plot of average yearly income per person versus average yearly oil consumption in barrels. And you see U.S. consumes per person vastly more than China or India where we ve got huge populations. And China, in particular, wants to grow, and it will grow. And in terms of transport it s growing very rapidly, a lot more than one percent demand. So if these countries want to grow, they re going to be importing more than their allotted one percent. The Asian-Pacific currently imports 18 percent of world oil supply, and, of course, as you can see from that plot it would soon be wanting to import a low more. Europe currently imports 12 percent of world oil supply. Again, Europe will want to be importing a lot more.

So in terms of business use, in my view, it cannot be done. We cannot -- in the next decade it cannot be met. Assuming one percent a year demand growth, the world will reach peak oil in around 2016, at which time every importer will want more oil than it can get. So without alternatives, competition will vast lead to major price rises, drastic competition and economic stagnation, which is painting not a particularly nice picture.

And now, why, if this is the case, why

do so few people talk about depletion? I mean, because there are so many desperate views, a lot of paralyzation of views about these things, some people even get quite heated about it. But I think few talk about depletion for many reason. But IEA and EIA are really only concerned with short term interests. They have to answer to their subscribers. In terms of the U.S., the U.S. subscribes to the IEA for the 40 or so countries that pay them, and they don t really look at longer term forecasts, and which I think they should be doing.

OPEC certainly they don t want to talk about depletion because they -- OPEC wouldn t want to wish to encourage everybody to invest in alternatives because it would mean prices would decline.

USA, USA doesn t talk about depletion, perhaps because high reserve estimates, which USA generally says much higher than -- global reserves is much higher than most of the other countries in the world. They would use -- if U.S. started saying how much less oil, then people would regard USA as an economic problem.

Other oil producing governments, in

particular, the U.K. and other governments, they don t want to talk about depletion because they want to encourage all companies to explore. So it would be very negative for them to have to talk about depletion.

And, certainly, environmentalists, they would be the last people to talk about depletion, because oil is a target in the global warming battle. If they believe the oil production would decline, then it wouldn t give them so much power. But, of course, some of the replacements for oil are more carbon dioxide toxic than oil is itself.

And, finally, the oil companies, do they talk about depletion? Well, they have the Stock market to think about. They do not want to admit future growth constraints. And they bought -- if you look at what the oil companies are doing right now, despite of lack of opportunity, it s already forcing to cut costs. They re cutting costs dramatically.

You think, we ve had higher prices for some years now, and they ve been cutting costs, laying off people, certainly outside of the U.S. They ve gone to explore the most extreme and politically risky areas there are. If there were any easy options they would be going there. They wouldn t be exploring deep waters. They re campaigning for release of environmentally protected areas, which doesn t give them a good PR. They re targeting the more difficult options such as stranded gas, LNG, gas to liquids (inaudible) which is growing quite dramatically. They re tinkering with alternatives, which like with Shell and BP they ve got (inaudible) and solar, departments which make no money at all. And their forging mergers and alliances has been massive reduction in the number of oil companies in the world.

And but one thing you d think they would be doing would be looking harder for more oil and gas, certainly with these high prices. But if you look at actually wells drilled since 97, we ve seen a general decline. And my forecast for wells drilled from 02 to 07 it continues it s decline. I mean, this is despite pretty good prices, different from what was occurring in the 80's when prices were higher. This decline in drilling, I mean, you may argue that it s due to better success rates, but when prices were high in the 80's drilling dramatically increased regardless of success rates.

To me it confirms there is a lack of prospects, and especially oil prospects. And it s not just confined to North America. Globally our numbers are only increasing in our last oil frontier, and that s deep waters, which is not going to impact greatly on production. So, generally, that s what --

I ve just got a series of conclusions just to wrap up the presentation. Firstly, we accept that oil and gas are finite resources. Drilling has been concentrated in the best areas, so if you start putting -- looking at less perspective areas, and giving it large volumes of potential oil, it is pretty unreasonable because oil companies are not stupid. They go for any area that is valid.

A good example is Eastern Greenland. Greenland has been looked at over and over again by oil companies, and they haven t found much. They haven t done much drilling because it s extreme climate. The chance of finding anything significant in Greenland is pretty small because oil companies have already tried, and with the technology we have today, we can get a pretty good idea of what s around.

And also, the first fields to be discovered were the largest and cheapest. I think that s faintly obvious. New technology increases production, but it hardly increases reserves. Instead, it speeds depletion. It does increase reserves a little, but mostly it speeds depletion. So the world faces an oil shortfall in the median term in the next decade or an oil production peak sometime in the next decade.

Meanwhile, as this happens, OPEC s share is as high as it was in the early 1980's. It s about 38 percent right now, and it is rising. While as most non-OPEC producing companies are already struggling to meat demand, U.K. and Norway, in particular.

Gas, of course, can replace some oil, but it certainly can t replace it easily in transport. However, gas also has its own limits. If we -- really, if you believe this model of oil depletion, then gas will have to replace or certainly (inaudible). And because of that, there is going to be a large demand for oil -- or for gas throughout the world, which would require huge investments and major competitions between the regions in the countries.

Thus, in my view, global energy supply is already a political risk because of the impact of the OPEC cartel, or potentially attach more (inaudible) the seven OPEC s -- the key seven OPEC suppliers is near maximum set by physical resource limits. And global energy supply will soon be a physical risk. The OPEC countries have some spare operational capacities, but they, too, will struggle to meet demand as production declines elsewhere.

Currently, really, only Saudi Arabia has spare gas. All the other OPEC countries need large investments in order to increase their capacity. And that takes time. It takes three, four, five years. And as I want to stress, it s timing that s important.

So somebody will say, oh, people are always saying there is going to be a -- people have said since oil began that we re reaching a production peak. But in the 1970's the OPEC price band were reversed from exploration uncovering non-OPEC reserves in areas that had not been explored, and that s primarily offshore of the U.K. and Norway, offshore Malaysia, offshore

Australia. Many of these areas were explored largely off the OPEC price band and because of the technology to explore offshore.

But there are now few new places to explore. If someone could tell me these places, I d be interested to discuss it this afternoon, but, in my view, there are few new places to explore because I think the oil companies are pretty well explored everywhere. In the next decade, oil prices will, thus, rise, driven by resource constraints and not, this time, politics as has always happened in the past. And without no basic alternatives, that we permit these price rises because we won t be able to --

However, of course, there are alternatives. There are substitutes. Along with gas, the world contains large quantities of non-conventional or substitutes and renewables. But an unforeseen decline in output of conventional oil makes it unlikely -- of conventional oil makes it unlikely that unconventional sources could come on stream for us not to conversate.

If you look at the speed in which some of these resources could come on stream that develop the technology to create a hydrogen economy, for example, would take many, many years, and in the interim period there would be major problems with energy supply, and consequently, with investment capital to put in place to develop these alternative technologies.

So this will leave conservation the only option. And so I just end with a quote, Just as iron rusts from disuse, even so does inaction spoil the intellect. By Leonardo da Vinci. So that completes my presentation, thank you, which is a little bit different from the previous one.

PRESIDING MEMBER BOYD: Thank you, very much. Questions? Comments?

MS. PHILLIPS: I have a question. I was wondering when you said that for environmentalists oil is a target in the global warming battle, so there is little talk of depletion. Can you expand on that a little bit?

DR. SMITH: Well, it s a little bit of a throw away line because I m not very experienced on the environment, but I just feel that the environmentalists that I have spoken to don t want to consider the fact that oil might start -- the production of oil might start to decline in the next decade because it would really mess up all their global warming models for the next 50 years rather than the next 20 because they look long term as well. That s what I really meant. I mean, it s how I feel. It s not in their framework.

But on the other hand, for environmentalists, I mean, the main alternative for potential production declines is coal, of course, in China, which is polluting, and is Canadian oil sands, which is much higher carbon dioxide. And, of course, you need energy to produce the Canadian oil sands as well, so it s very high polluting.

PRESIDING MEMBER BOYD: Dave, I m going to allow you a very quick question, because we need to move on, and you have more per capita.

MR. ABELSON: Did I understand correctly that the essential difference between you and the first speaker is you re forecasting some sort of a peak in approximately 2020, and he s saying the conventional wisdom is buzzing around 2040, and the difference has to do with expanding reserves and undiscovered resources? Is that, in essence, the difference between you folks 20 years and some assumption about what s not been brought up yet?

DR. SMITH: I would say, yes. I would agree. But, obviously, it s two people. Would you agree that s in essence that s the difference?

DR. GAUTIER: Yeah. I think the principle -- we may have some disagreement on undiscovered resources here, but the principle disagreement, I think, technical disagreement here concerns this question of growth of reserves in existing fields.

And, again, I think the fact that we, in our study, are not -- we are specifically explicitly not predicting the production peak. We are estimating quantities of undiscovered conventional oil that, you know, our view could be made available through technology and scientific understanding as it exists today. We are not predicting discoveries or production, but we re talking about volumes of oil available, conventional technology which might be available.

PRESIDING MEMBER BOYD: Okay. Thank you, Dr. Smith. Dr. Cavallo.

DR. CAVALLO: Okay. I m going to take a very different approach to this problem, as you ll see. So I hope it s -- I hope it adds something to this whole discussion. Just an outline of what I m going to talk about, just some background, look at increasing demand and finite supplies, I think there is no question that -- among anybody that demand is going to increase. What s happening out in the real world is just amazing. Oil and gas is going to be -- oil, in particular, is going to be in great demand.

But we know oil supplies are finite, and so the debate is when will oil production peak, except that there is no debate, really. You never see this discussed -- virtually never see this discussed in the media. So I d like to take a new approach with a new model, I think that is more transparent than anything that has been proposed in the past. I m going to use the data from the USGS, which I believe they are accurate, and just apply a very simple model to that, talk about the results and then look at possible price trajectories and some conclusions.

Well, we begin at the beginning. This is world primary energy consumption as of 1999, and you can see that oil is 39 percent of that consumption. And there is a reason for that. It s the most versatile, the most convenient, the most useful form of energy that we ve got, high energy density, can be turned into all kinds of things. There is no real substitute for that stuff. It s just wonderful stuff. That s the reason why it s 39 percent. We have natural gas and coal 23 percent, 22 percent, approximately equal percentages.

So oil is really the problem. The solution to the problem, it makes possible a very comfortable for many people, and there are many more people who would like to have that comfortable lifestyle. So, demand is going to increase. In fact, actually, I should say that projections to 2025 indicate that this pie chart looks about the same. Oil will provide about 40 percent of primary energy consumption in 2025. That s the conventional view.

So some background. Increasing demand is driven by population increase, where population continues to increase, and also, that population is industrializing, especially in India and China. We know they re building car factories in China and in India. They re building super highways in India. Those folks want to live the same way we do. They see television and they know how we live, and they want the same sort of standard of living that we have.

The projected world annual increase in energy and in oil, in particular, is about two percent a year, a little over two percent a year, according to the EIA. Now, this is exponential growth, and the problem with exponential growth is that it kind of creeps up on you. But it s relentless, and in 20 years, two percent per year growth means you need 1.5 times as much production in 20 years as you ve got now. And that s quite incredible. So we re supposed to go from 75 million barrels per day in 2002 to about 110 million barrels per day in 2022.

And these are numbers, especially this 27.4 billion barrels per year, that s current consumption. That s a number to keep in mind. With all these numbers flying around, you should just keep a few of them in mind, and that, say, 30 billion barrels per year, that s a good number. So when you hear reserve estimates, divide by 30 billion barrels a year to give you some indication of how much that really means.

For example, the reserves in Iraq are always quoted as about 112 billion barrels. That sounds like a lot until you divide it by 30 billion barrels, and you see that that s -- Iraq could supply the world for about four years. So that puts things in perspective, and that -- Iraq has the second largest proven reserve. So considering -- when you consider that fact you sort of wonder what s going on out there.

Historically, we ve had about a one and a half percent increase over the last decade. So these numbers are rather confusing. I think it s important to be able to put them in context, but them in perspective, and that s the way I usually do it.

Okay. So the debate is, conventional petroleum reserves are finite, production has peaked in the U.S., U.K., Egypt, or is flat, actually. That s the other thing that most people don t realize. You don t necessarily peak. You go to a plateau, and that s seen in many, many areas, actually. But that means you can t satisfy increasing demand, and we ll look at this more closely a little bit later.

So the question is, when will oil production peak? What are the reserves? Where are the reserves, in particular. That s really important. They re not here in the United States. We re going to have to import a lot of that. They re not here in California. Who has got the reserves and what does that mean? What are the alternatives? Well, there actually are very good alternatives to oil, but I think there are alternatives, especially conservation and energy efficiency. But that won t happen unless we make it happen.

And there is no debate. And why is that? Well, public interest groups, I think, believe that the greenhouse effect will limit consumption, not resource constraints. And I think that the comment is that the Stone Age didn t stop before people ran out of stones.

I think that the other reason is that people have been burned so many times predicting a peak in oil consumption that they just don t -- people will feel that they lose credibility if they take that angle and take that tact, and it just won t pay. It s been too many times and people have been made fools of too many times. It s just not good, not a good strategy if you want to convince people that they should change their behavior.

Well, there are organizations that are supposed to warn us about these things, and one of them is the Department of Energy s Energy Information Administration. And they have an annual energy outlook, the 2003 version is out, and that makes predictions out to 2025, and everything is fine. Business as usual out to 2025.

There had been an analysis using the USGS data where they predict a peak in oil production at 2027. I know the people who have done it. They don t believe that number, but that s the number a lot of people picked up on. And if you look at how they arrived that number, it s really not feasible. It s just not credible.

European Commission, the European community has a report. I have a report published in 2001. They worry about European reserves being depleted, and they say they look at North Sea reserves. They say by 2025 they ll be gone, even with the most optimistic predictions of reserves, they say they are gone by 2025. However, they also -- buried in the report is a comment that there will be no overall problem in reserves

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through 2025.

They provide no justification for that statement, no references, they just -- it s buried in the report, which I find quite extraordinary. Again, I think it s a reflection that people have tried to predict this peak in oil production so many times and have failed that you just can t talk about it anymore or have any credibility.

Now, the CIA, actually, has a date. When I was in Washington I had spoke with a colleague about my work, and I told them my date for peak production, and he said he didn t believe me, of course. So we called up his buddy in the CIA, and he said, when is oil production going to peak? And back came the date 2025. This is not widely reported, of course. The CIA doesn t publish in journals, but they are thinking about the problem and they probably use USGS data and do a slightly different analysis, and they come up with a date of 2025, which is actually pretty reasonable based on USGS data.

Okay. Reasons for non-issue. Don came up with a prediction from I think 1888 or something like that. I beat you, see. I come up with prediction of 1874. Probably the same geologist in Pennsylvania stated that the U.S. would run out of oil by 1878. And he had a whole bunch more predictions, but again and again people have predicted catastrophe, and again and again they ve been wrong. The club of doom in 72 came out with very pessimistic predictions. USGS in 1981, much lower reserve estimates.

A really interesting example is Colin Campbell in a Scientific American article in March of 1998, predicted a peak in 2004. By December of 1998, oil prices had dropped to $10 a barrel, the lowest, probably, in the latter part of the 20th Century, and it made his prediction look extremely foolish. It s just totally wrong.

Now we all know that oil reserves are finite, and sooner or later there will be a peak, but what s wrong with our approach? There is something wrong with what we re doing. And the reason for this is, I think, that, for example, if you look at Campbell s article there is no discussion of the economics, why oil prices are what they are.

Market price, as we ll see later, is decoupled from production costs, and so there can be wild price fluctuations, and the fact that the price dropped to $10 a barrel in December of 1998 had nothing to do with reserve constraints, or they didn t discover any great new fields in 1998. It s just that Saudi Arabia had decided to enforce some market discipline by dropping the price to $10 a barrel, and they were successful.

The United States was in the middle of a constitutional crisis. We couldn t -- with the Clinton impeachment, we didn t pay much attention to that, or we couldn t pay much attention to that, so that s what happened. It was very successful, because after this happened prices went up to almost $40 a barrel. Fascinating when you start looking at what really goes on in the world.

But market price is not now a reflection of fundamental resource constraints, and it probably hasn t ever been, at least in the last 30 or 40 years. Another problem is the reserve estimates are problematic. Until recently they were very often back of the envelope calculations, just very crude estimates, how many square kilometers of sedimentary basins are out there, and you know, how much has been produced in these sedimentary basins.

You know, so they get some very, very crude estimate of total world oil reserves, and that s not good. Until the USGS estimates came out, we recall didn t have good reserve estimates, no good way of making these calculations. So these -- the USGS work, I think, is really incredibly important.

Very often there are not error bars on the reserve estimates. They re out there as if this is the final word. Or people use proprietary reserve estimates. Colin Campbell, in particular, does this, so there is no way to check any of the conclusions that people come to. You can check my conclusions by using the USGS data and some other data that s in the public domain and see what you think, whether I m crazy or not. It s very easy to check what I m going to be going through.

Also, poor models. No analysis of assumptions or limitations. People usually use Hubbert s approach, the logistic growth curves, but there is no geophysical or physical reason for production to follow a logistic growth curve. It s just, you know, it s very -- it s a very, very unsatisfactory way of doing things. You can -- I think my model is much easier to understand,

and a much better way of approaching the problem.

However, Hubbert was successful in one case in the United States. I ve written a paper, by the way, if you want to copy, I d be happy to give it to you, where I look at Hubbert s method and analyze why it succeeded in that one case and why it s fairly difficult for it to succeed in other cases.

Okay. So the question is, can a forecast be made that s useful to consumers and producers, like folks in California? One that will alert them to problems so that alternatives might be put in place. And the question is, this is a useful versus useless prediction.

If I walked up to you and said, you re going to die, that s a useless prediction. I mean, everybody knows they re going to die. If I walked up to you and said, you know, I ve got the results of your blood tests. Your cholesterol is 350. Your good cholesterol to bad cholesterol ratio is .1, and you re 200 pounds overweight. You ll probably die of a heart attack in five years if you don t do something. That s a useful prediction, because you can do something about that. You can say, I don t believe you. I m going to get another blood test. One way or another, you can validate the conclusions that you re being fed. So that s a useful prediction.

So can we make a useful prediction? Useful to California, specifically. What are the requirements. Well, we have to have believable reserve estimates. That was the one thing that Hubbert did have. He had believable reserve estimates. And the reason for that was, as Don mentioned, the Texas Railroad Commission was running the oil business in the United States, and they required good reserve estimates to allocate production.

So they really did have good reserve estimates, and Hubbert made use of that. That s what we haven t had for world oil production because there is no Texas Railroad Commission running the world oil industry, unfortunately, or fortunately, depending on your point of view. I think we would actually be much better off with cooperation between producers and consumers, but that has not happened.

So Hubbert had good reserve estimates. We haven t had good reserve estimates, except for these crude back of the envelope calculations, until the USGS came out with their world petroleum assessment. So that study is really critical, and I take that data -- take those data.

And then we need a transparent model, something that people can see and understand intuitively. Not some -- not a logistic growth curve, which is not very -- not very good. Okay? And we must also understand the market rules. The oil business is a business. It s people go out and find oil so that they can sell it to you and hopefully make a lot of money. So we have to understand the market rules, otherwise we ll be flailing around.

Okay. So first, let s try to understand the reserves. And everybody knows now that supplies are abundant. And there is a good reason for that abundance, and it s been alluded to a couple of times, and that is that there have been profound advances in geoscience -- in the geosciences and petroleum engineering technology.

We all know that there have been lots of advances in computers and medicine, in telecommunications over the last 20 years. It s a completely different world. What most people don t realize is that there has been a similar revolution in the petroleum industry. Plate tectonics, for example, in the sciences, we now understand how the world -- the surface of the world works. That wasn t the case in 1973. That wasn t the case when Hubbert made it s predictions. It s really good when you have the science to understand what s going on. We didn t have that until this theory came along.

We know about oil formations, source rock, migration and trapping, much more. You know, when Hubbert made his prediction in the early 70's or early 60's, this was much of a mystery. In addition, we -- all major sedimentary basins have been explored, and more remote or deeper deposits are being developed.

Now, this has also been discussed, and people aren t going after these deeper deposits because they want to prove how much hair they have on their chest. They don t do it for that kind of thing. They do it because they have to because the other regions -- the easier the area, the more accessible areas have been explored, and they have to go after more and more inaccessible areas. This is a real sign that, you know, things are getting tighter and tighter. But because of advances in science and technology, you can go after these areas and make money on oil in these very inaccessible areas.

So, on the one hand, that s a sign that things are getting tighter. On the other hand, you can still make plenty of money on those deposits, so there is no signal. There is no price signal to consumers.

Some other advances, three dimensional seismic surveys, have revealed the world to us. Lateral drilling, again, reducing costs quite a bit. This is FPSO. I just threw that down there to show there are lots of acronyms around there. Floating Production Storage and Offloading platforms that are used to go after much smaller deposits in the North Sea.

The trade press is full of this sort of stuff, and it s just full of all kinds of great information if you know what to look for. The corollary to these advances in engineering and science and technology is that much better reserve estimates can be made. And this, I think, is not widely appreciated. And that s what the USGS has done.

Okay. Let s look at the markets. This

is a business. These folks aren t producing oil just for the heck of it. They re not philanthropists. They re doing it to make money. How profitable is this business? If it s not profitable they re not going to be in business. What are production costs now and in the future? And this is just a quote that I found in a recent article, 2003. Non-OPEC finding and development costs have dropped from $22 a barrel in 1981 to $6 a barrel in 2001. That s in 2001 dollars. That s quite incredible. That s really quite incredible.

And this is a statement by the head president and CEO of Schlumberger, Limited, one of the major oil, I guess, lobbying companies. They know what they re talking about. He should know what he s talking about. But that s really not enough. We want to get some more hard data. So one of the marginal lifting costs in existing fields, that is, you got a field out there, how much does it cost you to get some more oil out of it. These are quite incredible data.

For OPEC they ve broken it up. This is from EIA, an EIA publication. References, I can give you all the references. I don t make this stuff up. References are in my papers. If you want more details, I d be happy to provide them. For OPEC, this stuff is dirt cheap. It comes out of the ground, you know, at almost no cost. These are in 1998 dollars per barrel. There is an awful lot of oil. This is probably that Saudi oil, down around 50 cents a barrel. Okay? Not a gallon, a barrel.

Non-OPEC oil is a bit more expensive, $4 to $5 a barrel on average. So you can see that these are very low costs relative to the market price. And we have to, of course, compare this to the market price.

What about new fields? Current fields are very profitable, indeed. What about new fields? That s what we really want to know. Well, for OPEC, they re down here before five bucks a barrel, dirt cheap still. And these are based on proven reserve estimates. Okay. For non-OPEC, the costs are higher, considerably higher. Probably these are 1998 figures, probably from the mid 90's, and I think costs have actually dropped, but from that Schlumberger comment, I think costs are probably closer to $10 a barrel for exploration, development and operating costs.

That s everything. Okay? For new fields. Again, pretty low.

Profits, I mean, we ve got to make a profit on this stuff. So what s the market price? The OPEC price band is $28 to $22 dollars a barrel. So the conclusion is that market price is decoupled from production costs for both OPEC and non-OPEC producers. And that s really important. And that s why you see these wild, wild price swings.

It s got nothing to do with production costs and everything to do with politics and the ability of OPEC to get the price they want. And I don t think people appreciate that. Certainly, most people don t appreciate that. Although the information is all out there, that s not understood.

So, as an economist would say, market equilibrium does not exist. And what this means for producers and consumers is amazing. It s -- for the producers, of course, this means delectable margins. This is very nice. This is a very profitable business. But for consumers, as well, this is very good news because consumers get the oil they want at affordable costs, producers make excellent profits, just everybody is happy as a pig in wallow, you know. What more could you want?

And the question is, how long has this been going on? Well, this is -- this is U.S. wellhead price from 1996 dollars between 1990 and 2000. And this has been alluded to as well. There were wild fluctuations in the price. Actually, this underestimates the price dip in the -- at the start of the depression. Prices actually declined to probably around a dollar a barrel on this deal, which was a disaster for oil producers.

But here you notice there are no price -- wild price swings. This is the year -- these are the years when the Texas Railroad Commission controlled the business. The price was fixed at a dollar a barrel, nominally, no matter what. This was very nice for the producers. And the question is, of course, what were the production costs?

And if you look back at the really brutal debates that went on before this system was put in place, there was some who actually said, you know, the free market should take its toll. All those inefficient oil producers should go broke. Too bad for them. And the ones who are most capable will take control after that, and everything will be just fine.

Well, it turned out those inefficient producers had a very strong voice in this matter, and the inefficient producers won. From testimony before the Texas legislature, we know that oil could be produced from the best fields, if you use good engineering and good science, at a cost of about four cents a barrel. They set the price at over a dollar a barrel.

So for many, many decades now, since about before 1935, there has been no market equilibrium. The price of oil has been -- market price of oil has been decoupled from production costs, and everybody was happy, until here when OPEC, which actually was formed or took control -- it was formed in 1960, actually. They didn t take control until about 1973 when U.S. production -- actually, U.S. production couldn t keep up with demand long before that. But OPEC was formed based on a Texas -- the experience of the Texas Railroad Commission. It s no mystery where they got their ideas from. They took them right from Texas. It was such a great idea.

So, what are the consequences of all this. I think this is really important to view this as an entire system, not just look at reserve estimates but understand the business side of this, because that s very important. It s one big interconnected system. It s not just reserves. It s not just production. It s not just OPEC. It s also non-OPEC. So what does this system -- the consequences of the way this system worked, what does that -- what does this all mean? Well, it means that the market -- because there is no market equilibrium, market prices decouple for production costs, market price gives no indication of how rapidly reserves are being depleted.

Market rules favor maximum rates of current production for both OPEC and non-OPEC. Now, the Texas Railroad Commission didn t have a problem with this because if you overproduced your quota, you were visited by the State police, and they would shut you down and they would actually throw you in jail. OPEC doesn t have that kind of authority. They could, but they don t have that kind of authority, so that s the reason you get these OPEC members trying to cheat because this is so lucrative, there is so much money to be made.

And, of course, non-OPEC members want to produce as much as possible.

So more expensive, in contrast as what you would normally think of as a market where the lowest cost reserves are being produced first, and then higher cost reserves later produced, more expensive non-OPEC reserves are being depleted much faster than low cost OPEC reserves. And finally, prices may decrease as production approaches a peak, because what we re going to do, as we ve seized control of the Middle East oil fields, is ramp up production in Iraq and force prices to go down. Okay. But that s -- we ll come to that a little bit later.

So, given this is the way the market works, what about a model to try to predict when oil will peak based on the USGS data? So market stability we assume. OPEC, relative stability. Okay? Not absolute stability, but OPEC rules. They re the swing producers, and they will increase supplies as demand increases, or decrease supplies as needed to maintain that price -- the price within that price band.

We need the decision criteria. This is from my background in radiation work. Decision criteria, how do you decide when production is going to roll over? That s a very important point. It doesn t just come out of the blue. It s -- we can make a fairly straightforward decision criteria, and that is, production plateau or peak, where the USGS proven plus undiscovered reserves to production ratio drops to between 10 years and 20 years. And the economic reason behind that is that nobody will increase production after this point, roughly, since the future of the enterprise is threatened. Now this is a hypothesis. Okay? So you can actually go out and test this hypothesis.

We re also going to aggregate and disaggregate reserves and producers. Everybody just sort of lumps all producers into one big lump. You can do that, of course, and I do that, but you can -- it s very interesting when you start disaggregating these producers to see where the oil has to come from. You get to find out that there is some very important things that are going on.

For example, if you assume that oil is going to -- just going to -- oil production in non-OPEC members will just keep continuing to rise, you find out that while the little -- that most of the reserves are in the former Soviet Union, and at some point the former Soviet Union is going to be the only place that will be capable of increasing production, and they re just not going to do it.

Okay. Also, you assume all undiscovered oil is discovered and marketed as rapidly as needed, and you can assume a two percent demand growth or one or three percent. So where does that get you? Well, first of all, you say horse feathers. This is nonsense. You ve always been wrong before. You ll always be wrong in the future. The USGS is a bunch of armchair geologists. They don t know what they re doing. You just got to trust the good ol boys to find all the oil you really need. That s what you ve always done in the past, so just keep doing it.

Well, you don t have to do that. With this model, you, too, can go out and validate the model. You can take the USGS data. You can take the -- the production statistics that are also in the public arena, and look and see what s happening out there. What s happened is that we now have many more years of experience, many more non-OPEC oil plays are well-developed and have plateaued or peaked in production. And if USGS has done it s job right, that should be reflected in this reserves to production ratio.

So using this available production data from -- I used the petroleum economic of world oil, examine production trends relative to the USGS data. And so what does that look like? Well, it looks like this. Now, these are all non-OPEC oil producers that want to produce as much as possible. All of these, except Angola and Brazil, have plateaued or declining production, and all of them fall in this band of that happening when the reserve to production -- the reserve of proven plus undiscovered -- proven plus undiscovered reserves to production falls to this ratio between 10 and 20 years. Okay?

So it looks as if the USGS data is actually pretty good. I mean, in spite of Don s warnings about how these are all estimates, actually, it seems to be turning out okay. One exception is this one, Gabon, which has very high reserve to production ration, 80 years, but it has declining production. And so the USGS may have been wrong there, or there may be some political problems there. It s a relatively small producer.

The United States also has fairly large reserve to production ratio, but declining production. And this is probably due to the fact that the United States is a fairly high cost area to produce oil in, and it s more lucrative to produce it elsewhere for oil companies to go elsewhere and look for oil.

Denmark is another exception. They re way down here. Their production has actually plateaued, and it s very interesting because they re getting their oil production from structures that aren t on the geology maps. They re very peculiar structures that one wouldn t usually think of as being oil producing structures. That s also fairly small. It s about -- it indicates that, you know, the USGS doesn t always get it right. But this is a -- this kind of data would indicate to me that the USGS has done it s job property in estimating oil reserves, and that this model is a reasonable model for trying to understand what s going to happen in the future.

Okay. So it s very simple. I take the USGS proven plus undiscovered reserves. Their third category is this reserve growth, which you can t use to increase production. And I think that assumption is validated by this graph. Just take that, divide it by production and see where you are. Okay. If we do this for the non-OPEC reserves, you can see that for the two percent growth, which is predicted by most people, you hit a reserve to production ratio of 20 by the year 2010 for non-OPEC producers, and it hits 10 by the year, something like 2018.

So one would predict a peak in non-OPEC reserves -- non-OPEC production between 2010 and 2018, something like that, roughly there. Now, that assumes -- well, given all those assumptions, those assumptions I ve made, if you look at world oil reserves versus time, again, proven plus undiscovered reserves, and do the same thing, world oil reserves, reserves to production ratio dropped to 20 years by around 2020 and 10 years by around 2028.

So there still will be plenty of oil out here, of course, because of this reserve growth, assuming that exists. We don t fall off a cliff, but this gives you some sort of idea of where we expect a production peak, both in non-OPEC and in

OPEC reserves.

Now we ve assumed that we ve aggregate producers and we have full cooperation among all the producers. And this is especially unrealistic as one approaches a peak, both for OPEC and non-OPEC producers. I think once you have a peak production or a plateau production in most areas around the world, other producers will get the idea that why should they increase production? I mean, they know that their reserves are finite. They product is going to be even more valuable in the near future. So this could have a snowballing effect, so you have to take these results with some sort of warning.

And you also have to assume that all undiscovered oil is found and produced as rapidly as needed. And this is somewhat unrealistic, especially for the deep offshore -- it looks like it s actually you can go after this stuff and bring it into production fairly rapidly. But for the former Soviet Union, where reserves are more and more remote, and you need very expensive pipelines to get it out, I think that s unrealistic, and so you may find a non-OPEC peak actually coming close to the 2020 -- 2010 rather than 2018.

Now we need a -- it s kind of a sanity check on all of this, especially for the reserve estimates. I think it s important not to take that as the USGS is gospel, and so we can compare this to other reserve estimates. The USGS listed here about 3,000 billion barrels of oil. Again, you have to watch that because a lot of that -- about a third of remaining oil is in this reserve -- reserve growth category, which is not available to increase production. It s only available for plateau production or to moderate the decline.

Campbell uses proprietary reserve estimates. They are below 2,000 billion barrels, but a lot of the other estimates are up above -- between 2,000 and 3,000 billion barrels of oil. These estimates were all made, basically, on the back of the envelope around 1980. They are taken from Tissot & Welte s book, which is a classic book on petroleum occurrence and formation. And they re really not very useful for understanding the problem.

The reason the USGS estimates are so useful is that they re so detailed. You can look at each petroleum producing provence, look at the production statistics and the reserve estimates from the USGS. None of these other -- None of these other reserve estimates can you do that. So the detail in the USGS estimates are really quite valuable. And you can -- as I say, anybody can check this sort of thing. Go to the web. Get the USGS data. Go to the World Oil and Gas Journal or the Petroleum Economist and get their production statistics, and you will, I guarantee you, you will get the same results I got.

So it s all quite comprehensible, but what does it mean for price? That s really important, because most people take their cue from the price of oil, and that s what makes this whole problem so difficult is that we don t have a market equilibrium. The market price is decoupled from the cost of production, and so we re in a real bind. You can t do much with that kind of a system. I think with the old system, OPEC domination, we will have a long production plateau after 2010 after we hit a non-OPEC peak, and then a gradual price rise, not an abrupt price rise.

I think this is actually good. It s a good way to get out of petroleum. It s not a bad thing to have -- totally bad thing to have this kind of system with OPEC in control basically supplying not all you want, but close to all you want, and warning people that this is a finite resource and that they better do something about it.

Now, what s happened in the last, let s see, three months is that we ve got a new system in place, I think. The United States has pretty much taken control of the oil fields of the Middle East. I think one of the objectives will be to decrease the price. And this will be possible because current prices have nothing to do with production costs. As we ve seen in that earlier data, production costs in the Middle East are extremely low. Saudi Arabia, 50 cents a barrel, a couple of cents a gallon.

So production prices can easily drop to around, I think, about 15 to 20 dollars a barrel with a rapid increase in consumption. And when that happens, of course, the consumption -- of course, you re putting the peak even closer. It s very bad for sort of the long term, but it will suit the U.S. very well in the short term. And this will lead, I think, to a market collapse in the long term if this is actually what happens.

We ll know in a year or so.

But there have been statements in the paper from Cheney indicating that he wants Iraqi production to be up to three million barrels a day by the end of the year, and that could well be possible, given the resources available.

The advantage of the new system to the United States is that it buys support for war or wars, plural, from U.S. voters. U.S. voters just love cheap gas, and so do lots of other people. It will remove resources from those likely to challenge U.S. domination. High prices give lots of money to people who don t agree with us, and that s a danger.

Full control of oil also allows the U.S. to dictate the rules for the world economy. I think nobody is going to challenge us when we control the cheap oil and we re setting the price.

So there is an alternative to all this, and I would suggest something like a policy of surcharges and rebates. And I think gasoline taxes are very bad. You can t tax gasoline. That will -- that is instant death. But I think something like a surcharge where you phase in a

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three dollar a gallon surcharge on gasoline, and then rebate these surcharges immediately monthly to consumers, and they can either use that money to cope with higher gas prices or to put a down payment on a hybrid automobile.

It gives people a warning that this stuff is not infinite, that we re dealing with a finite resource, but yet, it doesn t penalize people. This taxing -- the problem with taxing gasoline is that it s another way for the rich to steal from the poor. We ve got enough of that going on right now.

I think this kind of arrangement would get around that problem and yet still give people the message that they need to receive that looking at the price realizing that this stuff is not forever, but doing it in such a way that they can cope with it constructively, not just -- if we wait until the price rises thanks to resource constraints, I think we ll be in a very bad position, which is where we re headed.

Okay. So where are we after all this? I think science and technology now allow us to make good reserve estimates. Those reserve estimates have been done by the USGS. If we understand the market rules, that is, we understand why we see all these wild price swings that have nothing to do with resource constraints, we can allow credible predictions to be made.

I would state -- see a production peak in the near future between 2010 and 2020, closer to 2010 if the U.S. takes control, as I think it will, and drop the price, but somewhat later under OPEC. And the amazing thing is that I think we ll see cheap gas until the peak is clearly visible, and the peak won t be clearly visible until you hit a resource constraint, and then it s going to be too late to do anything much about it or it will be very painful to try to do something about it.

I think U.S. dictated production rates will lead to a much more chaotic transition to a sustainable economy.

And, finally, I think alternative are technically feasible and affordable, and I think that s what we want to do to make sure we head in this direction. So, that s it.

PRESIDING MEMBER BOYD: Thank you, very much. Comments, questions from the panelists or folks in the audience? Thank you. We ll hopefully get some more of the panel discussion time this afternoon.

And I think we want to finish with our morning agenda soon, and our speaker next has asked that we do that. So our next speaker is Kathryn Phillips, and while Kathryn is taking the podium I ll give you some background, which I didn t do this morning since she was missing.

Kathryn received degrees from U.C. Berkeley, good school, University of Missouri, and University of California, Los Angeles. Ms. Phillips is a senior policy advisor at the Center for Energy Efficiency and Renewable Technologies, which is a non-profit coalition of environmental organizations and renewable technology companies that are dedicated to reducing fossil fuel dependence and improving air quality by promoting renewable energy, energy efficiency and energy conservation. Ms. Phillips conducts regulatory advocacy, produces research and reports that support certain schools, and engages in public and policy maker education, and is not a stranger to us around here. Kathryn.

MS. PHILLIPS: Thank you. I m going to be talking about Petroleum and California, and Is

It Time for a D-I-V-O-R-C-E, with apologies to Tammy Wynette. I ll share a little bit, generally, about how environmentalists think about this issue. And Dr. Smith, while I agree with you that there probably some environmentalists who are not as eager and anxious to talk about the potential peak and the potential reduction of supply, some of us are quite eager to talk about that because we re hoping that maybe there will be a wake up call that will help reduce some of the other problems that petroleum presents.

And as I was thinking about California and this petroleum issue, it came to me that some of the things I ve read by the great thinkers, Dear Abby and Ann Landers, how informed this discussion. And what I believe is really the key issue, and that is, regardless of supplier demand or even economics, there is compelling reasons that we have to reduce our petroleum dependence in this state and the world as a whole.

So I propose that California can -- the situation with California petroleum can be explained in this form of what would you do with a divorce situation. The paths to a divorce court, there are probably five ways to ruin a marriage.

Probably more, but these come out of Dear Abby, remember, and it s not extensive. Drinking too much, smelling bad and making breathing hard, essentially suffocating somebody, leaving filth everywhere, spending money frequently and carelessly, and ignoring desires. If you do that, you re likely to end up in divorce court.

So how does that apply here? Well, California has an expanding petroleum appetite. California has, as you know, a love affair with the automobile, and probably about 67 percent or so of every barrel of crude in the State ends up going to fueling cars or trucks with gasoline and diesel. We ve had a consumption of about 1.4 billion barrels daily, and that s been increasing.

Between 82 and 99, gasoline consumption increased by 35 percent. We don t see any indication of a decline. As you know, some of you may know that the national fuel efficiency average, the fuel economy average has been declining slightly, and Californians are as guilty as anybody else. Despite our professed interest in the environment, we re as guilty as anybody about buying automobiles based not on fuel economy but based on comfort.

So we have moved in the last several years from being a net exporter to a net importer. Internal demand is up and crude oil production is down. So I think this proves that we do have a drinking problem.

Petroleum related air pollution, that counts for about 60 percent of the reactive organic gases and 80 percent of the nitrogen oxides, all of which adds up to ozone when you mix it with sunlight, and we have lots of sunlight in California. Petroleum generally plays a leading role in California s very famous air pollution problem. Petroleum related air pollution generally includes not just refinery remissions, but also tailpipe remissions.

Nearly 65 percent of California s air pollution is from motor vehicle exhaust. There is some new interest or increasing interest in the effects of non-road diesel vehicles, and a couple of -- there has been some national attention to that. In a report that came out last week, indicated that non-road diesel vehicles represent about 64 percent of the particulate matter contribution of vehicles.

And particulate matter is particularly

important because there is increasing evidence suggesting that that s a key aggravator for asthma, other lung and heart ailments. And the State s Air Resources Board has made particulate matter a pollutant of particular interest.

Petroleum also pollutes soil and water. Brown fields, brown fields are those typically areas within industrial -- or sites that have been industrial or had industrial or commercial operations that have left residues behind. About -- there are probably about 90,000 brown fields in the State of California alone, about at least half -- people who track brown fields say at least have are linked to petroleum products of some sort. Petroleum or petroleum related contaminations, the most common -- one of the most common contaminants found in brown fields.

Leaking tanks are another problem. The figures for the effects of MTBE leaking from tanks are running into -- hundreds of millions, depending on whose numbers you believe, but the estimates seem to grow by the day. And that s mostly because of concerns about it s effect on groundwater supplies and water pollution, both from leaking tanks and from surface water, as well as -- not direct -- direct spills from pollution -- for petroleum, but also accidental or sort of secondary spills from use of motors on waterways.

So, in other words, petroleum is leaving filth everywhere. Petroleum pollution costs Californians an incredible amount each year. Depending on whose figures you use, the range is quite wide, but even the low range is high. Mark Delucchi and a number of associates at U.C. Davis have over the years done a number of different studies looking at the health costs and other costs of petroleum pollution when considered from motor vehicles -- motor vehicle remissions as well as refinery remissions. Some of the fears -- And I put in 2000 dollars because most of their studies were done in the mid to early 90's, and they relied on 1991 dollar figures.

So if you update those figures, they figure the health costs in California are 5.9 billion to 63.9 billion, just in the LA Basin. Nobody has done something for the entire state. But if you take that lower figure and you multiply it a few times to take into account some of the other areas of the state that have non-attainment and nearly extreme attainment, you get up to a huge number.

Another researcher, Jane Hall, did a study in the early -- also in the mid 90's, but hers -- her numbers were based on the 1990 Census and data. She looked more at the benefits of reducing petroleum pollution and -- or meeting air quality standards in Los Angeles Basin. And if you take -- if you be fairly conservative and say that at least half of the problem in the LA Basin is due to petroleum, motor vehicle emissions and refinery emissions, you would come up with a figure that s around -- in 2001 figures, around $6,000,000,000. So that s pretty much in the ballpark with Delucchi if you look at Delucchi s lower figures. That s just for health costs.

Visibility, that s another problem. California relies a lot on tourism. We have a lot of natural vistas that people come from around the world to see. The particulate matter reduces that visibility. It also has an effect on residential home prices. Anybody who s tried to live near the coast where there is less pollution knows.

Agriculture, the interesting thing about agriculture is one of the greatest reasons for crop loss has to do with air pollution. And I only have U.S. figures. That s all Delucchi had either. And they re very high, but one could assume that probably considering what a large part of -- what a large part California plays in agriculture, plus the fact that a lot of our agriculture is in the Central Valley, which now is suffering from pretty significant air pollution problems, that is more than half of that agricultural loss is probably in California.

Petroleum pollution also deprives Californians of what they want. Just about every poll indicates that Californians regard themselves as being very concerned about the environment and consider themselves environmentalists. And top among the concerns is air pollution.

These figures are from a 2002 Public Policy Institute of California poll in which they asked folks to identify the most important environmental issues facing the state, and Californians were able to identify the specific problem. And most likely, ones they named were air pollution, development and sprawl and water pollution. Two of those top three are linked to petroleum product pollution. Development and sprawl could be identified as something that helps encourage petroleum product pollution if you consider that the development and sprawl leads to greater travel by personal vehicles.

So the paths to divorce courts, we ve seen that California has a huge appetite for petroleum, so it drinks too much. We re suffocating from the air pollution. It s a continuing problem although we ve made advances in some portions of the state. Other portions have become worse. Filth everywhere. We have 90,000 brown fields, probably the significant portion of which are related to petroleum pollution. Spending money frequently and carelessly. We ve got the high costs -- health costs, agricultural costs and tourism costs, materials damage. Those are all indicators of spending a little too much. And ignoring desires. Californians really do prefer to have a cleaner environment.

Unfortunately, divorce is not an option. So what do you do? Well, the first thing is, you admit there is a problem. So beyond the economics, which I ve enjoyed today s discussion so far about supply and what the supply is and isn t and what some of the economic predictions are and the very creative approach to using economics to control consumption of petroleum.

But even beyond those, the threat of a looming disaster on supply or price spikes, I think the evidence suggests that we have environmental costs that need to be addressed and haven t been addressed, and the best way to address those environmental costs is to figure out a way to reduce petroleum pollution, and ultimately, maybe, to reduce our demand and dependence on petroleum.

The cleaning up the pollution is one approach. Replacing, retrofitting, in the short term, diesel engines, has been a fairly successful program in California, but it s consistently underfunded. Brown fields clean up, leaky tank cleanup, those are both things that we can do to reduce the effects of current petroleum pollution.

But preventing future petroleum pollution is a much more complicated situation. Some of the things that have been addressed and the state is trying to do includes zero, near-zero emission vehicles, introducing those, promoting those, mandating them, more alternative transportation, buses that run on time.

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One of the -- One of my pet peeves is that I take the bus quite a bit, and if I have to -- if I miss it by three minutes it another half-hour wait. So if they came more frequently I d be a happier camper, and I d probably be able to ride the bus more frequently.

Alternative fuels and infrastructure. This is something we ve been talking a lot about in the state, and that is how do you -- how you get to a point where you have maybe something as -- can you actually introduce a hydrogen economy, a hydrogen based economy to a place? Is that a reality? And one of the things that has come up with the ARB and in other places in the fuel cell partnership is looking for ways to encourage development of vehicles that would rely and be reliable, that would rely on hydrogen fuel, and how can you make that fuel in the least polluting most cost-effective way.

And then, how do you build that infrastructure. These are all huge topics, any of which I ve sat in numerous meetings that go on and on and on and we come out of them with not any real strong answer, but at least we re discussing it and we re looking for ways of addressing it.

The best thing we can do is figure out a way to -- once we admit that we need to reduce our dependence, and certainly reduce the effects of petroleum pollution, then I guess we can start the serious talking about how we do it. And environmentalists, at least in California, aren t talking about how can we reduce our dependence on petroleum pollution, and we re hoping that as future months role around, workshops like these, maybe we ll find more consensus, especially from the industries that petroleum and power and fuel industries that recognize that we can t be entirely dependent on petroleum, that there are too many costs for society. We ve got to look for some alternatives. Thank you.

PRESIDING MEMBER BOYD: Thank you, Kathryn. If I might ask you a question. You didn t include improving vehicle efficiency on your list of things to do. Was there a reason for that?

MS. PHILLIPS: No, there wasn t. It was just an oversight. And I think somebody else mentioned that earlier, too, and that s a good point. Improving vehicle efficiency is certainly something that has to happen.

That s why I thought what Dr. Cavallo suggested was so intriguing, the idea of using -- increasing the price of gasoline and using that surcharge to encourage people to buy more efficient vehicles. That was something I hadn t heard before, but --

PRESIDING MEMBER BOYD: There is a debate going on over that, which might provide you a forum to push that discussion.

MS. PHILLIPS: Thank you.

PRESIDING MEMBER BOYD: Any other questions or comments? If not, I thank you all. Thank you for your additional patience. We got a late start, so we just about used our allotted time. We re just behind. But lets come back from lunch, if we could, in an hour.

(Whereupon, at 12:25 p.m., the workshop was adjourned, to reconvene at 1:38 p.m., this same day.)

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AFTERNOON SESSION

1:38 p.m.

PRESIDING MEMBER BOYD: Let s get started right away with Mark Finley from BP who is standing at the podium and has been waiting for his opportunity. Okay. Take it away, Mark.

MR. FINLEY: Okay. Thank you. First, thank you to the Commission for the opportunity to speak here today. BP has a significant presence here in California, especially under the brand name of Arco. And we do appreciate the opportunity to be a part of your conversation on this very important issue.

What I would like to do is address the issue of prospects for world oil markets over the next five to seven years, with a particular focus on the outlook for non-OPEC production and to challenge conventional wisdom.

This is a bit of a shorter window than any of our previous speakers have focused on, and I did that for two reasons. One is because that s where I can see best, but I think that it will enable us to draw some lessons for the longer term. And it also will enable me to speak more directly to your questions about OPEC and market power.

The conventional wisdom that I would characterize is that non-OPEC production will falter in the years ahead. Here in the U.S., for example, oil production is viewed to be in terminal decline. And I would like to propose, however, that there is a strong probability that U.S. output and non-OPEC output in general will rise through the rest of this decade.

I ll show the consensus is still that there will be -- excuse me -- a decline in the U.S., but we at BP have been calling for growth in the U.S. for over a year now, and at least one of the leading consultants is now moving into our camp. I m sorry I m not current on where you are in your projections for U.S. production, but we ll get a chance to find that out next.

Why am I so bullish? I will illustrate key forces that play around the world by looking at the U.S. as a case study. Here in the U.S. the answer is mainly the deep water Gulf of Mexico, and you ve heard about that a good bit already this morning. A major technology driven play is already underway both here and around the world. But in addition to that, we ll also see that improved technology is another significant factor enabling the discovery and exploitation of greater resources at lower costs.

So, first, the question -- and the big picture we re looking at the distribution of global proven oil reserves, and the question -- and the answer to the question of, will demand for OPEC oil rise in the future? Forgive me for lapsing into a bit of economics jargon here, but, duh. You know, two-thirds, in fact, 80 percent almost, of the world s proven reserves are within OPEC member countries.

At some point production must inevitably follow the distribution of these reserves. But the debate is over when this will occur. And for those of you here who aren t a pointy headed nerd like me, I ll elaborate on the line on the bottom. What Keynes said about the long run is that we ll all be dead by then. So the important issue is to focus on what happens between now and then.

So, again, what I ll do is first review some historical trends for context, then I ll use the example of our analysis of the United States as a case study for challenging the conventional wisdom. That will lead us to laying out a different potential path for the oil market through the end of the decade, and we ll have a chance to offer some conclusions.

So, first, the historical data. I think it s important to note that OPEC s market share has not been rising for at least a decade now. The line in blue here shows total OPEC market share, and the orange line below it is the OPEC share excluding Iraq, which made sense to do up until a couple of weeks ago, because OPEC had not -- or Iraq had not been part of the OPEC court arrangement for the last 12 years.

OPEC s share was roughly flat for most of the 1990's, a time of moderate, if not record low oil prices, and the strongest economic growth in a generation. This obviously follows -- I m sorry. The last couple years has seen a deterioration in OPEC s market share, and this is on the back of OPEC s successful strategy of defending higher prices but giving up market share to do so.

We think that the demand for OPEC oil

this year is likely to fall for the fourth consecutive year in a row. This next slide shows some history where oil production has changed over the last 10 years. It s a very busy slide, and I apologize for that, but that, in fact, is my point. So what I want to show here is, these are countries that have increased production by at least 100,000 barrels a day over the last 10 years, and there are 21 of them. A couple of OPEC countries, and those are underlined, but most of them are non-OPEC countries.

And, in fact, of the 10 and a half million barrels a day of increased production that is represented in this pie chart, OPEC accounted for only three and a half million barrels a day of that increment, and most of that was down here in Iraq and Kuwait following the rebound from their zeroed out production during the Gulf War.

Among decliners there was a much smaller list of countries. And we see, in fact, that OPEC members counted for about 40 percent of the decline as well. The United States, you know, where we are in decline, Russia, and we ll talk a little bit more about that next, I am not intending to suggest that Saudi Arabia or the

U.A.E. are seeing their production declining because of resource problems. This was because of the mechanics of OPEC quotas. In Indonesia, uniquely among OPEC members was production falling because of the inability to sustain production levels.

Moving on to Russia, Russia showed up as a big loser on the previous chart, but that masks significant downs and then ups over the course of the decade. A significant production decline due to the collapse of the Soviet Union and the economic and political chaos that followed that, and then more recently, production increases. In fact, production increases in Russia alone in the last three years have been sufficient to meet all of the growth in world oil demand over that same period.

We think that this production increase has room to run for at least another couple of years, and it s important to note that this is all homegrown working on the existing fields. This is not a frontier exploration for which there is still talk about bringing in a foreign investment.

And so to the conventional wisdom. The

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is from the International Energy Agencies World Energy Outlook from last year, and the DOE s long term outlook is very similar. What it shows is that OPEC s market share will rise from about 40 percent in 2000 to about 55 percent in 2030. The solid red at the bottom is Middle East OPEC numbers, and the thatched area represents other OPEC members. And other regions are broken out as you see here. And important to note a significant decline in other non-OPEC production, including in the United States.

PRESIDING MEMBER BOYD: Excuse me. How do you define non-conventional there?

MR. FINLEY: Yes. This is primarily the Canadian tar sands. In effect, I did want to note that in the reserve data that I showed in my first slide that we do at BP follow the Oil and Gas Journal convention for most countries, and so in this year s statistical review when we put out new oil reserve numbers we will be putting out a much higher number for Canada to be consistent with their inclusion this year in the Oil and Gas Journal database. That data, however, hasn t been published yet, and so it wasn t reflected in the slide that I presented.

And so to our case study, using the U.S. for an example of what lessons we can learn about the prospects for non-OPEC production, and the key factors that are at play. First, I won t dwell on this because we ve seen this chart about 100 times already today. U.S. production peaked around 1970 and has been generally falling. You can break it out and see that there has been a substantial decline onshore and in the shallow water offshore. We ve seen, also, declines in Alaska, and we ve begun to see the deep water in the Gulf of Mexico come on stream.

Over the last two years, U.S. oil production has been essentially flat with continued declines in the lower 48 and the shallow Gulf of Mexico largely offset by gains in the deep water gains in the Gulf of Mexico. And, importantly, with Alaska, flat -- actually showing a very slight increase in each of the last two years.

And so now the conventional wisdom. I think this slide can pretty much sum up what we would characterize as the conventional wisdom. Onshore lower 48, here is the Hubbert curve that we spent some time with this morning, continuing decline in Alaska, in the deep water Gulf of Mexico ramping up, but because of the characteristics of the fields, you know, peaking very quickly and tapering off very quickly with the result being growing dependence on imports.

And, in fact, here is the Energy Department s view of the world. Flat domestic production through 2010, consumption that grows by about one and a half percent per year, with the result being that imports rise significantly and import dependence rises from 53 percent currently in 2000 to about 60 percent by 2010. And I want to note here that DOE has become much more optimistic in the last couple years about the U.S. supply outlook. A couple of years ago they would have been showing a significant decline in U.S. production through 2010.

So we ll move to challenging the conventional wisdom, and we ll do that looking through a variety of lenses. First, with Alaska, the conventional wisdom shows that, you know, expects a continued decline in Alaskan production. It s a very mature basin, but there is substantial evidence to -- substantial reason to believe that Alaskan production could plateau, you know, at least through the end of the decade. In fact, the state suggests that production will be above a million barrels a day for at least the next five to six years.

Supporting these developments are, for example, the dramatic drop in drilling costs associated with technological improvements that I ve laid out here, which have made previously uneconomic projects like the Northstar project economically viable. Note that when I m talking about Alaska and Alaska production plateauing, I m assuming no NOR, no NPR-A production.

Just to look at the North Slope to discuss some of the factors that play here, we have enhanced oil recovery projects going on, both within Prudhoe Bay and Kuparuk, the biggest producing fields up there. We ve seen some significant new discoveries in the last couple of years. Alpine, the largest onshore discovery in more than a decade, has been on stream for a couple of years now.

Another important development is that the fact that we have some cost and infrastructure that s enabling us to bring on smaller satellite fields that on their own would not be worth development. And that was, for example, coming here, Fjord, Nanuq Fields. There is various satellite fields elsewhere on the North Slope that fall into a similar category.

We also have heavy oil -- a layer of heavy oil deposits on the western side of these reservoirs that, again, through technological innovation we are figuring out how to produce economically. And this is -- these are resources that we have not been able to get to on an economic basis in the past.

Now, again, there is some significant uncertainties here. Price, obviously, is one of them, because this is one of the mature high cost, you know, forbidding terrain regions of the world. Also, frankly, the tax and policy environment in Alaska is they, like many other places, face budget deficits and pressures to close them. Also, significant issues with aging infrastructure, as well as access, of course.

Moving down to the lower 48, again, there is no issue that the lower 48 onshore, as shown in this chart, is in decline. But important to note that the rate of decline does seem to have slowed significantly in recent years. Effective the last six or seven years, the only significant drop we saw was in 1999 when prices collapsed. And, in fact, production has been fairly stable otherwise.

And now when we look at -- you know, in addition to that, just the volumes that are likely to be lost as we head into the future will be less over time just because we re working off of a smaller base. Again, new technology or better technology is playing a role in improved recovery rates in these mature fields, and this, again, does not count in our analysis any new access which could further improve the outlook.

Moving on to the deep water Gulf of Mexico. The conventional wisdom is that, again, production will peak very quickly and then taper off short field lives. But again, it s a very new provence. And so what we ve done is say, you can t just look at where the production is now. In effect, you can t look at that plus what has already been discovered but has yet to be sanctioned because we know that in a mature -- in a relatively immature basin like this there will be additional discoveries.

And so that s what we ve added up here

in yet to find oil in purple, and then because we know that these projects will see delays for various reasons, we ve risked that total back down. Even so, what we show and what we expect is that production will ramp up quickly, will exceed expectations, both in terms of the volume and the duration of that production.

I wouldn t quite put this in the cheap corporate plug, although it s getting close. When we talk about the deep water Gulf of Mexico, I just feel it s important to note that we do have a working interest in nine of the ten biggest fields that have been discovered in the deep water to date, and so we feel that we have a high degree of confidence in our projections.

Important to note here, now, this oil that really didn t exist, for all intensive purposes, 15 or 20 years ago. The first deep water well was drilled in 1,000 feet of water in 1979 in the Gulf of Mexico. As recently as 1997 the record for deep drilling was in 5,000 feet of water. Here we are six years later and we re now drilling in excess of 10,000 feet of water. We re also have been able to conquer the pressure and temperature and current issues that go along with working that far down in the deep water, and are still able to keep our finding and development costs in the vicinity of $4 to $5 a barrel.

So adding it all up, again, another lens for convention wisdom is looking at a reserve -- what has been happening to proven reserves in the United States. And, again, the evidence here is not consistent with the expectation of a significant decline in production.

Reserves have been rising over the last couple years, you know, some through extensions of the existing fields. This is the, you know, reserve growth that we talked about this morning, but also significant in new discoveries, obviously helped substantially by the deep water Gulf of Mexico.

Reserve replacement has exceeded 100 percent in the United States in four of the last five years, and discoveries per well are trending up again, obviously helped by the deep water Gulf of Mexico. Clearly, something is happening. It s a bit early to tell what exactly it is, but this is not generally a picture that you would associate with an area that s, you know, on the steep downward decline part of a classic Hubbert curve.

And so our bottom line is that production in the United States will grow by somewhere in the vicinity of a million barrels a day between 2000 and 2010. And, again, just for reference, here is what the EIA and the International Energy Agency are saying, and a couple of other consultants and companies whose forecasts we ve included while changing the names to protect the innocent.

It s important to note that this forecasts -- a number of these forecasts are creeping up over time. And, again, at least one of the consultants has recently put out a forecast that is similar to our view for the U.S. production for the next 10 years.

So when we put it all together, here s the view that we get of the U.S. production and consumption and import dependence picture. We see production rising by about a million barrels day. We re going to assume that consumption only grows by about 1.2 percent per year instead of 1.5 percent. And that s -- if you go back over the last 10 years and take 10 year rolling averages, that s what it s been, about 1.2 percent. It s also, by the way, what worldwide consumption growth over the last decade has been, averaging 1.2 percent per year.

So on that, if you take those two numbers and taking the DOE s estimate for processing gains, what it leaves you with is that you will still see an increase in imports of about a million and a half barrels a day, but importantly, the percentage, import dependence, doesn t change, 53 percent in both 2000 and 2010.

So, let s take some of these lessons and generalize them to get a different potential path for the oil market through the end of the decade. First, this is our outlook for non-OPEC production through 2007, and what it shows is the red bar increases by year in Russia and other republics of the former Soviet Union, and the light blue bars are production increases elsewhere. There is no doubt that high oil prices the last couple of years have helped the non-OPEC supply outlook.

We are looking at big increases from the deep water, not only in the United States, but also Angola, Brazil, Equatorial Guinnae, in Russia, most of -- in the former Soviet Union, most of the growth in the first couple years comes out of Russia, and then the back half you d have the Caspian coming on in a bigger way. And, again, this doesn t assume any new development of frontier areas in Russia within this time interval. There is also significant growth showing up in the blue bars in Canadian tar sands production.

While it s important to note that higher prices have helped this, you know, a lot of this production is going to be bullet proof to higher prices. I mean, like I said, the deep water Gulf of Mexico, new production in Russia and the Caspian is not going to be shut in if the price of oil is $15 a barrel, because production costs are well below that.

Now, even the Canadian producers, which many people view as the high cost production in the world today, say that they can make their target rate of return at prices of $15 to $18 a barrel.

So summing up for the marketplace, I ve got a slide here that I call OPEC s medium term challenge. When we look out over the next five years, say through 2007, if we allow world oil demand to grow by its recent historical rate of about 1.2 percent, we get a total increase in oil demand of somewhere between six and seven million barrels a day.

This next bar for non-OPEC supply is just the sum of the individual bars that we showed on the previous slide, and what it shows is the net change in the demand for OPEC oil is pretty much zero over the next five years. Add to that the fact that OPEC members are increasing their production of condensate, natural gas liquids, unconventional oil that does not count against OPEC quotas, and Iraq is coming back on line. I don t know who Ira is, but that used to say Iraq.

This is just assuming that Iraq over the next five years goes from current sustainable capacity of maybe two and a half million barrels a day to its previous peak, which was about three and a half million barrels a day that came both on the Iran Iraq War and on the eve of the Iraqi invasion of Kuwait. So I think that is a very conservative estimate for a gain in Iraqi production capacity over the next five years.

And then on top of that you ve got other OPEC members, most notably Nigeria and Algeria, pursing aggressive capacity expansion programs.

Depending on what happens in Venezuela over the next few years, you could add them to this mix as well. So what you have the potential of seeing is the situation for at least five more years where OPEC will struggle to see the demand for it s product flat to declining at a time where a number of its members are raising production capacity and, therefore, leaving them to struggle with increasing levels of surplus production capacity or cheat ability.

In effect, here is our bottom line for what could happen to the demand for OPEC oil over the next five years. A continued loss of market share.

And so just some conclusions. While it is true that production must eventually follow the distribution of reserves, we would say that there is a reasonable probability, which my boss, the infamous Peter Davies, would refer to as an English understatement. A reasonable probability that medium term non-OPEC production will exceed expectations. We see that the deep water, for example, it major technology driven play with substantial growth still to come.

And that we have seen demand growth

falter during a period when oil prices were very moderate and we saw the highest economic growth in a generation. Adding all of that up to us suggests that OPEC will continue to struggle to maintain market share.

Longer term lessons that we can draw from this, here are my first thoughts on the subject. First, it doesn t cost $25 to find and produce a new barrel of non-OPEC supplies. Technology will create new oil, but where and when, that s the part that we can t say. We will be both in terms of new discoveries and better recovery. Even mature provences, the decline will be later than and slower than we currently expect. Clearly, politics matters, and will it promote or restrict access to some of these reserves over time.

Looking further ahead, 20 to 30 years or so, at today from where we sit, it s hard to see where the new production is going to come from to sustain growing non-OPEC supply, but if history teaches us anything, and I hope that you can draw this conclusion from having sat through this presentation after lunch, and I hope that you re all still awake at the end of it, what history ought to teach us is that we should be prepared to be surprised. Thank you.

PRESIDING MEMBER BOYD: Thank you, Mark. Questions, comments, panel, audience?

DR. GAUTIER: Did you a price -- an oil price forecast in 2002?

MR. FINLEY: We haven t changed in response to looking at the market our long term planning price that we use for new projects, which is roughly $18 to $20 a barrel.

DR. CAVALLO: So, when will oil production peak?

MR. FINLEY: Who knows? I mean, it s --

DR. CAVALLO: Okay.

MR. FINLEY: -- beyond my ability to see. You know, the problem is we -- you know, we -- as far as we can see, it doesn t seem to be a problem. And I think one of the issues here, at least for me, is that, well, we hear a lot of people in the industry say, well, things look good for now, but we can t see how we re going to get beyond that.

And, to me, it s kind of shorthand for, you know, in Biblical times people will say, well, something happened in 40 years or something happened in 40 days and 40 nights. And it was because people couldn t count very high. And so 40 just kind of meant a long time.

And as far as I can tell, that s what 10 years means in kind of the oil biz. It s just kind of shorthand for, it s a long time, it s beyond our ability to reckon. Thank you, very much.

PRESIDING MEMBER BOYD: Thank you. Now we re going to hear from Blake Eskew, Purvin & Gertz.

MR. ESKEW: I ll see if I can remember how to work this thing. Very close. I d like to thank the Commission for giving us the opportunity to come out here and participate in this forum, and also thank WSPA who helped enable that process.

The theme of my speech, and the title, Resources and Requirements, is taking a little bit different thrust that I m going to try to bring here. We tend to look at oil from a -- or supply from more of an economist than a geologist s perspective, largely because we re not geologists. And so in our view it s a balance between supply and demand, what the market needs versus what the resource can produce. But really the key thing to understand as we look at these issues of long term oil supply.

The things that I m going to talk about today, the first is just -- the way that the market does tend to balance demand and supply, now everybody talks about it but you can sort of look at history, look at the future and see that that s indeed what happens and how the market works. We look at supply as an economic process, just as demand is, and that s our bias as we go through the presentation hearing.

The other theme I want to mention and watch for is our view of the price mechanism is very important in this balancing process of supply and demand, because what prices do is they drive the conversion of a resource into supply. One of our -- or Dr. Gautier earlier today set kind of the concept of resource versus reserve. We ve got other ideas of resource versus proved reserves.

In our view, resources don t do anything for anybody. Supply is what consumers actually consume and what solves the problems that they have that they need hydrocarbons for. And this economic process of converting a worthless resource into valuable supply is driven by the price mechanism.

Let me give you a little bit of background as well as talk about some of the other issues we re going to discuss today. You know, briefly, we ll look at both supply and demand. We ll talk about some historical trends, where we see some of the fundamentals moving, and then, again, more of an economic view of those fundamentals.

I ll give you a little background on Purvin & Gertz. We do technically based analysis of market fundamentals. Our technical background is in processing and distribution, oil refining, gas processing, transportation. It s not in upstream areas. And so when we look at production issues and long term supply issues, we look at them from an economic perspective, not a geological perspective.

And some would say that means is we re looking at it like economists. If we don t know the answer, we just assume it. That s sometimes true, sometimes not.

When you look at the past about 150 years of the oil industry there are some things that jump out at you. One is that production has continually grown with some bumps and bobbles during that time period, but it s been an incredible long term growth curve. Of course, that s, you know, part and parcel of the development of the modern world that we live in, just based on petroleum in many ways, but the industries that have driven our economic growth have driven our population changes are vitally dependent on petroleum and vice versa.

But this cross-reliance between the petroleum industry and the world economy is very, very real, and it s been driven by the capability to continually increase production. As we ve looked at this, our other speakers today have noted some of them, (inaudible) of the past that were imminently about to run out of oil.

What has always happened is the technology and innovation have been able to outpace the fact that easily available resources at the time have been continually used up, and we ve moved on to more difficult, more expensive, but in the long run, cheaper and easier ways to produce oil.

When you look at the physical supplies,

we ve had very few instances where a physical disruption has really caused a big problem in the oil markets. It s almost always been political, sometimes economic, but almost always political disruptions that have put us in jeopardy in terms of supply, that have disrupted the market and forced big changes in consumption patterns.

One thing to consider is the cost of oil. And we ve had several discussions today about what does oil cost to produce, what does -- you know, what is the relationship between the market price and then the various costs that go into it. And I guess our view is that they re not too far off.

When you look at the costs, and this is built up from an analysis of the reserve and cost disclosure data for the U.S. corporations, looking at the worldwide activities, incorporating both natural gas and oil putting it all on a BOE basis, what you find is the finding of development costs are down around $5 to $7 a barrel, ongoing production costs at about another -- about the same amount.

We built in a cost of an economic return, basically at a cost of capital recovery for the huge amount of investment that goes into oil and gas production. And then production taxes, which are a significant source of income to most of the countries that allow private companies to come in find and develop reserves.

And it s important for us to look at the total finding of development cost, not just the production cost, because as an ongoing business, every energy company knows that a barrel of oil produced today, if they don t replace that, then they ll go out of business. The Stock market certainly does not value their stock as a going concern if they are not continually finding and replacing that barrel of oil.

And so, the cost is not just this four or five dollar marginal production cost for a particular barrel. It s the life cycle, the full cycle cost to replace that barrel and produce -- and maintain the productive value of the entire company.

And the cost is really significant. If you look at Exxon Mobil, and we ll pick on them because they re the biggest, but you can look at their production over the past 10 years or so, it s been fairly flat on a combined basis before the merger, and then as reported following the merger, about four million barrels of oil a day. During this whole time they ve invested an average of about eight billion barrels -- or excuse me -- $8,000,000,000 a year in upstream capital. So about $5 a barrel per annual barrel of production.

A huge amount of plow back back into the business. This demonstrates that, again, for the energy industry to continue to supply crude oil you not only have to recover the cost to produce it, you have to recover these ongoing capital plow backs that have to be made. Otherwise, the resource will not be converted into supply as the market needs it.

Despite these huge capital requirements, non-OPEC production, which is the, in many senses, the high cost, the marginal barrel that s out there supplying the market, has been increasing over most of this time period. If you look back at the early 1990's, total non-OPEC fell pretty dramatically because of the collapse in the former Soviet Union. But if you take out the FSU countries, look at other non-OPEC, it continued to increase during that time period.

And then, as some of our other speakers have noted, the next few years, 2000 through at least 2010 or so, we have a very, very rapid anticipated increase in non-OPEC production, such that OPEC is going to have to cut back pretty significantly to avoid a very damaging glut in the world oil market.

If you look at some of these non-OPEC areas, and we think the Gulf of Mexico is really a very, very instructive example, and I ll try not to be too redundant with our other speakers today, but if you look at the shallow water Gulf, back in 1947, drilled the first offshore oil well and made the first offshore discovery, rather.

For about a 30 year period following that technological leap, the Gulf of Mexico upon average found about a billion barrels a year by reserve additions. It was obviously very spotty during this time. There was some huge peaks and some years in which virtually nothing was found. But over this very long period of time we continue to find on average about a billion barrels.

As you get out to late 70's, the place slowed down dramatically and slowed down much, much more in the 1990's. This indicates that the shallow water had really pretty much run its course. It was fully explored, fully exploited.

If you look at the deep water under the plot of cumulative reserves for the shallow water provence, it grew over this 30 year period up to about 35 billion barrels before it leveled out. The deep water production, which we plotted up here, or deep water discoveries over the first, say, five to ten years of this play, are following a very, very similar path of the shallow water.

Our view, again, naively or not, we look at the shallow water history as a reasonable analogy of what can be expected in deep water. And as you look at total -- or estimates of total resources availability in the deep water Gulf, they re in this ballpark. They re in the typically 30 to 60 billion barrels.

Of course, we don t know until it s found when these discoveries are going to take place, how fast it will take to develop them, what the quality of the oil is, any of the other details, but we do have a pretty good understanding from our clients and from our literature that the oil is pretty much going to be there.

And what this is is a very good example of how technology and the market opportunity, and the economics of production have converged to convert a resource into supply. And this supply we see growing, not quite as high as BP s current estimates, although BP is in a very good position to know exactly what the Gulf of Mexico is like and what it will do. We see total Gulf of Mexico growing for about a million barrels a day about five years ago up to about two and a half over the next five to seven years.

This peak is driven largely by some of the very, very big discoveries that have been made that are coming into production the 2000, four, five, six, seven time frame of the Thunder Horse Field, in particular. If additional resources, additional developments are found and brought into play into production to smooth out these peaks, then, certainly, this could plateau at a higher level, could certainly keep on growing past this level.

Again, the -- what drives our forecast is not an expectation of when somebody is going to find another billion barrel field, but an expectation on average that s going to be the type of discovery level that we ll see over the next 20 years or so.

And the interesting thing about this, when you look at the deep water in the State of Texas or any other geological area, and you say -- you compare this to what production would have been in Saudi Arabia or Iraq or the other countries that have continually cut production to manage the market, you know, it s a very, very different profile.

The -- and if you have -- if the non-OPEC or the OPEC countries that do control a vast portion of the world s reserves, if those resources were exploited in the same fashion, driven solely by the economics and production decisions, you know, I m not sure what Saudi Arabia s production would be now, but I m sure it would be several multiples of what it is.

Now, in addition to the conventional crude oil that s out there, there are many, many unconventional alternatives that are available to the market. And one of the key elements of all of these unconventional alternatives is that they don t really require massive changes in lifestyles for people consuming. They don t require changes in the capital stock that the consumers control. These are alternative ways to provide petroleum fuels that can pretty much be consumed just as conventional petroleum fuels are consumed now.

We talked about the oil sands earlier. This is a huge resource in Canada. It s a huge resource in Venezuela. There are other bitumens and oil sands around the world, and these are more manufacturing operations than oil operations as we know them, but these oil sands, once they re in exploitation, can be produced for many, many years. The experience in Canada has been that as companies have gotten better and better at developing and producing the fuels from these oil sands, the costs have continued to be driven down by the experience curve.

There are -- so there is other bitumens. There are oil shales in Australia. There are oil shales in the U.S. and there area oil shales in other parts of the world that have so far not proven economic. Perhaps they will in Australia. There is one plant that is currently operating.

There are -- we ll talk more about natural gas and gas to liquids, but natural gas, in our view, worldwide is such a huge resource that in many ways, particularly in gas to liquids technology, becomes -- proves itself economic as developed around the room. This is a huge potential addition to the supply of petroleum fuels.

Then, finally, there are bio-fuels, which, again, if technology could drive the costs down, bio-fuels could play a very, very significant role in meeting the fuel needs of the consumers of oil products.

Let s look quickly at natural gas. We ve gone back and looked at world energy supply since 1990, and what we did is, well, what if natural gas consumption had not increased the way that it did, say, over this five year time period that we project all these incremental five year time periods. And what we have found is that if -- that natural gas worldwide basically cut the growth in oil demand in half in the 1990's.

We think it s even a bigger impact over the next few years, and then ongoing after the next few years into what we consider the long term, 2015 and beyond. That as the huge resources in the Middle East, in Southeast Asia and north of Alaska, elsewhere around the world are developed, as technology to produce and transport natural gas improves, the costs will come down and natural gas will be a very important part of the total supply picture for the world.

But just to reiterate our conclusions here, our view is that if you look at the total cost to produce oil to the five developed -- excuse me -- to produce and market the oil, the per barrel costs have flattened. They re not going down anymore as they were in the early 1990's, but they re at about a $20 a barrel range, which is consistent with expectations for prices for I think most of the -- most of the consultants in the room anyway.

Over the next decade, we will see, we think, significant pressure from non-OPEC supply. And the challenge for OPEC is not going to be converting a resource into supply. The challenge is going to be cutting our production enough to keep prices from collapsing.

As we move forward over time, and as we look back in history, technology and changes in economic conditions around the world have been very, very important in increasing the access to the resource base, and then allowing those conversion of resources into usable supply.

And that process has really been driven by the price mechanism and the need of the market for that supply. The demand for petroleum products is really the -- one of the key elements in pushing this process forward and making sure that that demand can be met.

So let s talk about demand. Obviously, as we ve had supply go up, demand has gone up too or the supply would not have been produced. So there is a very, very long history of continual increases in demand for petroleum products. As with supply, political and economic disruptions have been more important than any kind of physical issues in terms of maintaining stability in the oil markets.

As we look historically, also, going forward, there are very important changes in technology and in the structure of the world s economies that have tended to continually reduce the energy intensity and the petroleum intensity of each of the countries of the world. And we think this process will continue.

And part of that is as demand increases and as we go forward, the ways that oil -- or the ways that oil is consumed continue to move up the value ladder. That the lower valued uses for oil become less and less prevalent, the higher valued uses become a more and more important part of the demand.

We anticipate the demand will continue to grow. We ve got a bit of a slow down here over the next few years with the economic problems we ve had, world economic problems that have resulted from a Middle East crisis. We anticipate that the economies will recover and we ll get back on a slow growth pace. In our view is somewhere between one and two percent a year for worldwide petroleum growth.

The biggest growing area would be in Asia, with China and India as the main drivers of that growth. The reality is that the people of China and India will never be able to consume petroleum the way that the people of California do. There isn t that much petroleum, and if you re go to Beijing, there aren t enough streets to hold the cars that they would have if they were consuming that much petroleum. But Asia is really the driver of a lot of this growth in demand. While North America is still a very important consumer, the growth is fairly limited.

I guess the good news in many ways is that the demand for petroleum is very closely related to price. The price does drive changes the demand, just as it drives changes in supply. Going back to 1960, we have very, very low oil prices, shooting up in the 70's with the Arab oil embargo, the Iranian revolution. And these time periods when the time shot up, demand growth went from four or five percent of the 1960's, you know, down to negative four percent.

It recovered very quickly in the mid 1970's, and then the very short price rise around 1980 resulted in very steep declines in the demand for quite a long period of time resulting in -- as you lost demand in the range of five or six percent a year over a several year period, that was a very large cumulative impact on total consumption within the United States.

Even more recently with the Gulf War with the spike here beginning in 2000, we ve had, again, a very, very sharp correlation between increased price and lower demand. And that tells us that the market does work. You know, oil is a product. It s a commodity. Oil products are just one of the economic factors that people and industries consume and that they -- it is responsive to basic economics.

Let s talk about economic structure of economies, and we summarized -- looking at the industrialized countries and the non-industrialized, the developing countries, that their consumption of oil per $1,000 of GDP, and it s been continually declining. In the industrialized countries in the past 20 years these countries have become about 20 percent more efficient in their capability to produce a dollar of GDP per barrel of petroleum.

You look at the development countries. Demand intensity was rather flat. These were about to mid 1990's, but since then it s entered a pretty steady downward trend. Part of this has to do with improvements in the technology of consumption, telecommunity, other -- instead of physical commuting, other ways to make it more efficient, again, to produce goods and services for a lower amount of energy.

In addition, particularly in the industrialized world, as the economies have grown, the proportion of the economy contributed by service sectors rather than manufacturing has also acted to continually increase the efficiency of the economy overall. And this, in our view, is sort of a natural limiter to the runaway demand growth that might otherwise happen if these economic changes were taking place.

We looked more closely at the U.S. market, not just U.S. but other markets, but the U.S. in particular, the U.S. is a huge market for gasoline fuel. U.S. bought -- consumes about half the world s gasoline demand. And so what happens is the U.S. is very, very important to total world petroleum.

And in our view, we re going to see over the next 10 to 20 years significant changes in the way that in gasoline consumption in the U.S., and really a leveling off of total gasoline demand. This is, we think, due to a combination of market factors, market pressures, as well as some changes and better regulations that we anticipate will occur.

But we re still -- jury is still out on whether global warming and the government mandates that go with that are going to drive significant in U.S. energy policy. I guess our view is, there will be some efforts made to increase efficiency of gasoline consumption.

One of the really key drivers is vehicle technology. The more efficient engine designs, the more efficient vehicle designs will push their way into the market. And this is going to be enabled by the changes in fuel composition that are going to be rolled through nationwide over the next few years.

You look at other issues, there are more problems that are caused by Americans love affair with cars and the whole car culture that we live in. You look in many areas, many cities have tremendous congestion problems. They have problems with high levels of local pollution. Many of these are going to be addressed for either mandates to decreased penance on vehicles, or just by consumers choosing different lifestyles, choosing to live in inner cities, choosing to use mass transit.

And you can see in a car crazy city like Houston, it s got a light rail system that s going to start up next January, and as a result of that, you know, you can look at land use patterns. There has been a huge boom in apartment and townhouse construction in the areas that are going to be served by this light rail system. So it will probably be the last place you expect, but it s going to happen there.

We think these -- Like I say, the other thing is that if you look at the choices of vehicles that American consumers have made over the past decade, there has certainly been more bigger, longer, heavier SUV s rather than smaller cars. You know, it s that -- that substitution run has pretty much gone about as far as it can go.

And, again, if you look at what the vehicle manufactures or sort of the market now for where taste and fashion is going, my view is that it s started to trend the other way, just as we saw, you know, we went from the tailfin Cadillacs of the 50's to the Ford Falcon of 1965 without any government mandates. Those same kind of changes in taste are going to occur again here in the -- over the next decade.

So as a result, our view is that gasoline demand will tend to flatten out somewhere after 2010, in that 2010 to 2015 time frame in the U.S. It doesn t take, you know, a complete conversion of the new vehicle fleet to hydrogen fuel sellers. All it takes is a higher level of adoption of hybrid technology, penetration of direct injection engines, which will be, again, facilitated by the low sulfur gasoline that s going to be mandated the beginning of 2004.

Some penetration, very low levels of alternative fuels, whether they re hydrogen, whether they re bio-fuels, whether they re electric, if that ever happens, we don t know. But we anticipate there will be some alternative vehicles coming into the fleet. And, again, it doesn t take a huge change in the vehicle fleet to really flatten out and level off the growth rate in gasoline consumption.

We have anticipated very little diesel penetration into the small vehicle fleet in the U.S. for some of the reasons that our earlier speaker alluded to, the issues on diesel toxicity, problems with controlling NOX emissions from diesels. But if those problems can be overcome by the diesel manufacturers and diesels do become to enter the U.S. car fleet in a large number, this could -- we could see what Europe is seeing now, which is ongoing decline of gasoline demand, even while diesel demand is growing. So, certainly, the possibilities of gasoline demand is flat are almost at best.

This kind of process we think will happen worldwide. As a result, when you look at the uses of petroleum, currently only about less than 10 million barrels a day is used for heating power, which is the lowest valued use. Industrial consumption will continue to grow. Transportation consumption will grow quite rapidly. The industrial includes all feedstock elements, so it s a pretty important part of part of the value of petroleum products. Using crude oil to produce plastics for cases for VCR s is, again, a pretty high valued application as much as me driving to the 7-Eleven.

But as you move out, this transportation and industrial segment becomes a bigger and bigger piece. We anticipate that he heating power consumption of petroleum will, again, be flat at best. And what s really driving that is big parts of the world that currently consume a lot of petroleum for basic heat and power, for example, throughout the Far East where you have big consumption of domestic kerosene, lots of consumption of residual fuel for power generation. We re seeing dramatic expansion in gas availability, and better regional gas movements that s going to take away most of that growth.

Okay. So just to sum it up, the key issue, is the availability of petroleum resource likely to limit the amount of demand that the world will have petroleum? Our view, we don t expect it to happen. There may well be a peak for conventional production.

I guess my personal view is a few years after that peak of conventional crude oil production happens somebody will write an article and note it, and then the world will -- may or may not pay attention. And the reason is that unconventional alternatives will have emerged, and we ll be supplying the consumer s need for the fuels that they use.

Again, you can call it an economic cliche or assumption of the answer to the problem, but we really think that the price mechanism and basic economic processes are going to govern and maintain this balance between world supply and demand. And when supplies are tight, prices go up, demand goes down. People go out and find more sources of supply. Eventually that supply pushes prices down. Demand grows, and we ll continue to see the same kind of cycles and volatility that have been a very important and unpleasant, in many ways, feature of the little markets over the past -- not just the past 10 or 20 years, but almost the past 150 years.

These cycles, this volatility are certainly unpleasant in many ways for consumers. There are opportunities for producers. They create transitions in economies and affect people s lives, but I guess as a student of economics, I don t see a way out of it, that those are -- that that very volatility, that very unpleasant process of adjustment to higher prices, to lower prices, to changes in consumption patterns is what makes the world work and what makes the market balance.

And that concludes my slides. I ll be glad to take any questions anybody has.

PRESIDING MEMBER BOYD: Thank you. Any questions, comments?

MS. PHILLIPS: I have a question. I was wondering, how long -- from what you ve seen over the years, how long do you have to have a significant increase in price to show significant change in demand on gasoline, or just crude? Either one.

MR. ESKEW: Well, you can see that when prices have shot up, usually, you know, within a year demand is declining. Now, is it significant? Usually it takes several years of demand declines for, you know, significant change in demand. But there was, I think, between 1979 and 85, which is where U.S. consumption bottomed out, I believe there was about a 15 percent reduction in demand. You had four or five years of three to five percent declines.

MS. PHILLIPS: So, you need to have more than a couple of months of high prices to see an impact on demand?

MR. ESKEW: Oh, certainly, yeah. Yeah. What you need is enough of a change that creates the perception in consumers and in producers that the world has changed, that their economic drivers are different, and that they then make different decisions. It has to be -- it has to extend over a long enough period to where the changes that are cumulative in nature have the capability to build some momentum.

For example, you look at the car fleet. You know, about eight percent of the fleet gets replaced every year with new cars. Obviously, you can t go out and make your old car much more efficient, but you can buy a new, more efficient car, but we can t replace 100 percent of it. So it takes, you know, several years to have a significant cumulative impact on the efficiency of the car fleet. But it s -- again, it s stronger than you might think because of the -- because of this ongoing replacement.

MS. PHILLIPS: I ve seen surveys JD Powers has done of consumers to get a sense of how high gas prices have to go before you would change the amount of driving you would do, and then how high they would have to go before you would actually change the sort of vehicle you drive.

And they have to get -- to go to $2.50 before people would start changing the way they would drive, and then $3 before they would change platforms, before they would think about getting into a more fuel efficient car. And that doesn t even deal with how long does it have to stay at that level. And we ve seen lots of price spikes in California that haven t really changed demand for the product because they ve been sort of short term. A summer long spike because of a refinery shutdown or something like that.

MR. ESKEW: Well, that s my point exactly, that it takes -- it takes a perception that the world has changed and you re at a different level, not that this is a transitory event that if I just wait a few months it s going to work its course.

So, yeah, you look at why does Europe have a car fleet that s, you know, 50 or 75 percent more efficient than the U.S. fleet? It s because they pay $4 a gallon for gasoline because of their tax structure. I guarantee if we paid $4 a gallon for gasoline, we d burn a lot less.

MR. ABELSON: Is your -- I m sort of (inaudible) --

PRESIDING MEMBER BOYD: Go to the mic. Dave you re the veteran question asker. You should have known.

MR. ABELSON: I guess I m struggling a little bit with whether you re trying to leave us with a takeaway message or just a set of factoids. And I m reading into what you re saying, but I m not sure that it is, so I m asking, actually. Is a policy in effect -- I almost hear you saying oil supply, per se, isn t something we should be worrying our pretty little heads about because the market is going to take care of it.

Now, that s not in terms of local distribution issues and so on, but as a matter of the supply itself, the supply and demand, that that s what I m hearing. Is that the message you re trying to convey to us, or am I reading something more into it than I should be?

MR. ESKEW: Well, it s like to put it in a nutshell, I m saying that in our view, limitations on the resource of petroleum are not going to affect the amount of petroleum that s consumed, at least in my -- in our time frame. By 2050, I don t go out that far, and I don t -- you know, I don t know.

But even if conventional crude oil does peak and decline, there are many alternatives to supply of conventional crude oil that some of which are becoming economic and are economic today that will continue to evolve to supply the need of petroleum consumers for petroleum products.

So it s definitely something worth worrying about. It s definitely something worth thinking about, and I don t want to make light of the issue, but our view is that it s not -- you know, there is not a cliff we re going to drive over, and it might not even be that steep of a hill.

CHAIRMAN KEESE: The history that we have seen with -- you know (inaudible) keeps coming in when the price rises, and then being depressed when the price is lowered. Taken together with the fact that the cost does not link to the price, which I think we re all in reasonable agreement on, at what point how much consistency in high prices do you need before you bring in the alternatives? And do you have a dollar figure where the alternatives will be economically justified for other investors?

MR. ESKEW: Well, what I do know is that today we have companies that are spending vast amounts of capital on gas to liquids projects, on bitumen and oil sands extraction projects. These companies, by in large, have an expectation of what s in the $20 barrel range or lower that they use as pricing to justify their projects. So it doesn t take $50 oil to bring these alternatives on. It takes some confidence that $20 oil can be sustained, but it doesn t necessarily take a higher price than that.

And, again, my arguments -- I take issue with the statement that the price of oil is not linked to the cost. And my view is that over the long term the price of oil certainly is tied to the cost to find it, develop it and produce it. Certainly, that s a much higher number than the incremental production cost.

But, again, as an economist, I say what is it that should set the price of any commodity? Well, it s the marginal cost of the marginal producer, which is generally the highest cost producer. Now, the highest cost producer is not Saudi Arabia. It s an investor in an oil company exploring where they can find the opportunity to do so.

DR. CAVALLO: In your projections, it seems if you are depending on OPEC to drop its production in the next few years because of --

MR. ESKEW: That s our expectation that they will.

DR. CAVALLO: What if they don t?

MR. ESKEW: Then we will have a price war and the price of oil will decline dramatically.

DR. CAVALLO: To where?

MR. ESKEW: I d say the recent past it was around $10, kind of a floor level that it is.

DR. CAVALLO: And another question. You have made projections, production -- non-OPEC and OPEC production. How do those relate to the projections of the reserve estimates of the USGS? Is there any connection?

MR. ESKEW: There is not an explicit connection there, no.

DR. CAVALLO: No connection?

MR. ESKEW: With the USGS reserve estimates?

DR. CAVALLO: Yeah.

MR. ESKEW: We haven t specifically taken the USGS s analysis, I believe.

DR. SMITH: So where did they come from, your predictions? I noticed you were still growing non-OPEC production into 2020.

MR. ESKEW: Yeah. That s just based on our view of where our investment was going and where the potential for additional production was as well as financial plans by countries and companies that are involved in those areas.

DR. SMITH: I just --
MR. ESKEW: Past 2010 the crystal ball is pretty cloudy.
DR. SMITH: I find that really hard to believe. In my analysis I just don t see practically that growth. In practical terms you cannot envision such a growth of supply in the next decade. But I would obviously have to see your data where you got it from.
MS. PHILLIPS: You re saying that some of these alternatives would be about $20 per barrel, the equivalent, that Dr. Cavallo raised? Is that what you were saying?
DR. CAVALLO: I did?
MS. PHILLIPS: Did you raise the alternative fuels, I mean, like the tar sands, etcetera --
MR. ESKEW: I didn t put a price tag on them.
MS. PHILLIPS: Did you say $20 a barrel?
MR. ESKEW: Something in there.
MS. PHILLIPS: Well, I m wondering --
MR. ESKEW: Twenties range.
MS. PHILLIPS: -- if you included in the price of the barrel some kind of compensation for

environmental damage, what do you think the price per barrel would be, both for regular conventional oil and for things like the tar sands, the GTL that s taken from natural gas in remote areas? Do you have any sense?

MR. ESKEW: No, I don t have estimates of that. If you look at the Canadians who were wrestling with this issue of what compliance with Kyoto is going to cost the tar sands producers, you know, most of their estimates are in the, I guess, a dollar a barrel, plus or minus, roughly plus or minus a dollar. That s the cost to maintain (inaudible).

MS. PHILLIPS: And then for like conventional, because I m sort of inspired by reading Tom Knudson s piece yesterday in the Bee, I m wondering if oil taken from Equador, if you were required to extract it and do the environmental litigation that you would be required to do if you did it in California or anywhere in North America, what would the price of oil be per barrel if you had to do that in all these countries, Nigeria, Equador, all these other places that have nearly non-existent environmental requirements for extraction?

MR. ESKEW: I would take issue that they re non-existent. There certainly are issues related to production in some of those countries, you know, some of the worst problems are in the former Soviet Union, not the places where U.S. or European governments have operated. So those are generally less expensive places to plot or produce oil than the U.S. is.

MS. PHILLIPS: What do you think if you did do the kind of environmental mitigation, though, that you d be required so that you didn t leave residue behind, that pipelines weren t breaking, that you ensured that there weren t scares on the Earth, that sort of thing, that roadways were done in such a way that you didn t have run off into streams, the kind of thing you have do to in the United States, what would the price of oil per barrel be?

MR. ESKEW: I don t think those things affect the price per barrel. I mean, some of those projects might not get done. I think most of them wouldn t. And then most of these countries, my experience is the companies that operate -- generally operate with a high degree of responsibility. You know, it s not the pipeline that breaks. It s the rebels that blow up the pipeline that cause the most problems.

PRESIDING MEMBER BOYD: We should save some of these questions for the panel discussion and get everybody s point of view on some of them. We should get our last discussion out on the table.

MR. ESKEW: Thank you, very much.

PRESIDING MEMBER BOYD: Thank you. We ll let Blake here off the hook for a moment. Thank you, Blake. Our next and final panelist is Sarah Emerson. Sarah wasn t here this morning, so I didn t go through her resume, so why don t I do that quick while she s going to the stand.

Ms. Emerson has a Master s Degree from John Hopkins University. She joined Energy Security Analysis in 1986. In 1991 she became director of oil market analysis where she developed many of the energy security analysis tools for analyzing the oil market and oil prices. In 1999 she became managing director of Energy Security Analysis, Inc., and has been and is an advisor to the U.S. Government on energy security issues. Ms. Emerson.

MS. EMERSON: I want to thank the

Commission for inviting me, and I want to apologize for missing this morning s sessions. I hear they were very interesting. I look forward to the discussion this afternoon, perhaps addressing some of the issues both from the afternoon and the morning.

I want to make one other comment about my company that I think may be relevant to our discussion. When we do forecasting, our sort of area of expertise is developing countries. And we have a process for collecting and forecasting consumption data, in particular, production data as well from every consuming country for every petroleum product. So when we look at some of these issues of demand, we re really -- we re building a pyramid that has a very, very wide base.

And in listening to the two previous speakers, I think one of the things I want to focus or shift the focus a little bit in my presentation today on is to talk a little bit more about some of these demand issues. Because it sounds as if we ve talked in great length about the actual resource base. And I think the issue of how much is enough has a lot to do with the demand side, and I think the previous speaker began to get into some of these issues. Perhaps I can go even further.

I also want to say that normally the kinds of presentations I make are forecasts. And I really deviated from the norm for myself in that I have presented -- I have sort of taken a scatter shot approach to try to explain how the marketplace works because resource adequacy really can t be viewed just in terms of volume, volume of supply and volume of demand. It is -- it needs to be viewed in terms of all of the other somewhat less physical factors which shape the marketplace.

If you will, the market is like an organism. It s got arms and leg and head and internal organs. It also has moods and behaviors, and we have to think of it in a somewhat more holistic approach. So I m going to try just to throw some of those items out today, but I do not have a specific forecast.

Oh, here is my -- hold on a second. At their basic level, this is the supply demand model that we all know. We have OPEC production, non-OPEC production on the supply side, developed country demand, developing country demand on the demand side. These four factors interact to create the price of oil.

I m adding a fifth factor here called he flow of funds because the oil market is not -- as I said, it s not just a supply demand beast. It also has a very important financial market component to it. And I will go a little bit into that. Perhaps I can take more questions afterwards, because I don t want to get too much off the topic today.

But this very simple supply and demand model has many things that shape it. On the supply side there is foreign investment. And this is one of the most critical issues in terms of determining what is resource adequacy in today s market. On the demand side we have environmental regulations, something California knows in great detail, and then you have taxation. And these factors all shape how that supply demand model works, how that marketplace works.

But there is more. There is technology. Technology impacts all aspects of this organism. It impacts production. It impacts refining. It impacts consumption. It impacts the financial instruments we use to navigate this market.

And there is one more thing, politics. In many respects, this may be one of the biggest unknowns. And when we re going to talk about resource adequacy, and we re going to talk about forecasting, you have to take into account political -- the future of political developments.

I am sorry. This chart is a little bit hazy. I haven t been in my office really since my invitation, so I ve been e-mailing things back and forth to my peer. What this is, this is just one chart I just wanted to touch on the flow of funds issue, because I m sure that it s a question that will come up.

And that is that the capital markets have something like $6,000,000,000,000 that flow all day, every day into and out of various instruments, equities, currencies, commodities. And as that capital flows into and out of things it has an impact on the valuation of those items, whether it s currencies, commodities, equities, bonds. And when it flows into commodities, it can flow into energy, generically, it can flow into natural gas, it can flow into crude oil, it can flow into heating oil, and it generally goes in through the future s market, but it can also go through the over the counter market.

And one of the things that we ve learned in the last 10 years is that the flow of money into and out of commodities effects the price, and sometimes it effects it very, very dramatically. What this charge shows us in the blue, it s a little hard to see -- this is a very short term chart. It goes from January through April. What it shows is data that is collected by the CFTC. And what it measures is the volume of trades made by one component of the players in the futures market.

In the futures market there are commercial players, which essentially are players that have equity in production or refining or something. There are non-commercial players, which are pure speculators, and then there are small traders, which is sort of an odd category that might include someone like a dentist.

And what the blue shows is it shows just the behavior of the non-commercials, just the behavior of speculators. And what s very interesting about it is when they develop a big net long position, in other words, they have more -- they ve purchased more contracts than they ve sold, the area is above the bar. And you can see they can push the price. The red line is the WTI price.

When they have more sales -- positions of sale -- excuse me. When they have sold more contracts than they have purchased, and they have a net short position, obviously they can push it back down. And this is one of those factors that I think when we get -- we all get so caught up in the volume of barrels, both from the supply side and the demand side, that we forget about this unbelievably enormous brother to the oil market, which is the financial markets, and they can have a very significant impact. They also can have an impact on financing in the longer term, and perhaps we can talk about that later. Anyway, that s my commercial for flow of funds.

Getting back to resource adequacy, the barrel here basically represents sort of the resource discussion that we had this morning. Reserves -- basically, the barrel is reserves, additions to reserves and production. That essentially is what we ve got here on the supply side.

Adequacy, however, is not necessarily

just based on what s in the barrel. It s based on price, technology, regulation of tax, and this big splat at the bottom, demand. And I m going to today talk a little bit at somewhat of a theoretical level about these drops.

And in this discussion I want to sort of lay out the debate. And the debate is most easily understood in looking at two relatively elegant thinkers on oil. The first on the left here is Harold Hotelling, a 1930's economist, who basically said -- he basically asserted he depletion argument. The future price of oil is an inclining curve because the volume of oil in the ground is a fixed and finite stock. And that was a view quite common in the 30's.

Obviously, many people have come in and said, okay, this is not completely true. We ve got technology. We have additions to reserves. And the most elegant -- in my opinion, the most elegant debater on the other side has been Morris Adelman at MIT who has said, basically, that, look, prices have been flat or actually declining in the long run because mineral depletion is, in fact, an endless tug of war between diminishing returns and increasing knowledge, i.e. technology.

And as Professor Adelman has said, So far the human race has won big.

And what we re talking about today is, is the human race going to stop winning big? Basically, if you believe Adelman, as long as the price of oil exceeds the cost of exploration, companies will continue to invest. This gets us to the issue of the price of oil, and I really liked the chart from the previous speaker on the cost of oil. I thought -- I m going to now present a similar view, but it s basically saying the same thing but with slightly different terminology.

This is how I see the difference between production costs and the price of oil. Production costs, let s say they are something up around $5. Investment incentive, which was in the previous presentation, I think it was -- I forget what the title was. Basically, it s the amount of money you ve got to make to make it worthwhile to do the production.

And then oil is an odd fuel or an odd commodity in that is has very long transportation distances. And so it has -- it carries this premium related to transportation, but it s not the premium that you would have, say, in gas, which is much more difficult to transport.

And then you have the top $10 or $15 of the price of oil, which is a risk premium. Risk that there will be problems with transport, political instability, regulations will change, OPEC will make crazy decision or illogical decisions, financial markets will get -- grab the market by the horns and shake it up, and now our new risk, terrorism. That s why the price is $27 and not the sum of these three.

Okay. I ll talk a little bit about technology. And when you have a market where the price is that far above production costs, frankly, this is a good business to be in. And there is a lot of room there to take that cash that you re earning and to invest it. And so, you can invest in frontier areas. And what we ve seen in the Western Canada oil sands is really the development of synthetic crude, which, you know, 10, 20 years ago you would have scratched your head and said, well, it s not clear how much that will develop.

Some of the estimates are saying as much as 2.6 million barrels a day by 2012. I don t know. I don t know if that number is good or bad.

There are issues. Kyoto protocol is increasing the cost to the producers. There is a need for natural gas in the process, and then there is some issues with refining configurations and whether the right heavy crew differential will make this profitable for a purchase. But the important point here is, you can make enough money in producing oil to go in and develop something like this.

Yet another frontier that is being developed, in Venezuela, they say the estimated recoverable reserves, 270 billion barrels. I m sure that s a Venezuelan number. We already have four joint venture projects which got underway before the Chavez government got into power, and they are producing between four and five hundred thousand barrels a day now, and will probably rise in the next year or so.

Obviously, there are concerns about this source. Are they in or outside the OPEC quota? You have other issues with political and regulatory risk in Venezuela, of course, but this is a business that allows you to go into a region like this and, again, to help synthetic or upgraded crude or emulsion.

Here is another interesting thing. I mean, here Venezuela has very cleverly developed something that can compete with fuel oil, and it does, in Italy, China, Japan and Canada. And it s so cheap that in some of the cases -- in some cases these customers have been able to retrofit their power generation plants and pay for all of the environmental controls they require because the input cost is so cheap. It s something on the order of $4 a barrel.

So, anyway, the point I want to make is really the technology is really what keeps moving the frontier, the oil frontier forward, and I think Mark mentioned this when he was talking about the Gulf of Mexico. We keep getting into deeper and deeper water.

Another point I want to make about technology is, there is a lot of talk about upstream technology, horizontal drilling, 3D seismic imaging, the FPSO s, which are these ships that you can put over several fields and then pull oil into one ship and then use it as an offloading structure. I mean, there is a lot of talk about that. I know very little about these technologies. They seem to be fairly impressive.

They keep cropping up. There seems to be a new one every four or five years. But that s not the point here.

The point I want to make is the downstream technology. Refiners have made just amazing investments and applied dramatic new technologies over the last 20 years to take a barrel and stretch it. So you can take -- you know, you can take a really poor barrel of Venezuelan crude that might not have been economically viable, and you can turn it into wonderful gasoline that you could even sell in California. And that s because technology is also on the consuming side of the business.

Okay. Let s turn to regulatory reform. And this is one of the things that I think sometimes gets sidelined in the debate over resource scarcity or resource plenty or resource adequacy, whatever we want to call this. And that is that regulations change. Sometimes they change quite dramatically. Sometimes they change in countries where you never thought they would ever change. Foreign investment law, we ll talk a little bit about that.

Environment, I mentioned lead and

sulfur. Obviously, here in California in the United States, we re way beyond those kinds of changes, but the rest of the world are making those changes in their fuel specifications as well. In fact, given that this organization knows so much about fuel specifications, I don t really think we ll spend too much time on that.

Industrial policy, countries all over the world are deregulating their petroleum sectors. Each country seems to be doing it in a slightly different way.

And then energy security. Energy security has reemerged in the last couple of years, in part because of 911, in part because of the war in Iraq. Countries that have never considered energy security measures before are beginning -- are taking them into consideration now. We just finished a study of all of the countries in the world that are considering strategic reserves, and there is close to two dozen.

And I can tell you there is a lot of talk and very little action except in two, China and India. And we do believe they will build those strategic reserves, and they will be fairly large. And it will not be easy for their economies, but they re going to do it.

This is sort of an obvious chart. More producing countries mean more regulatory regimes. If you look here in 1980, there were 80 countries that produced oil worldwide. We now have 106 that produce oil. Obviously, you re going to think, well, I m cheating on this chart because what happens here is the Soviet Union becomes 15 countries and Yugoslavia becomes, what is it, four or five or whatever it is.

But what s important about that is, it s not that this is more production. It s more regulatory regimes, more places where you can go in and if the foreign investment environment is favorable, and they re gradually all becoming favorable, you can go and produce oil in countries where you maybe never even considered producing oil.

Now, getting back to the foreign investment issue. All of these countries that I ve listed here at one time, if we were sitting together 10 years ago, maybe 15 years ago, we would have said, oh, they ll never allow foreign investment. Venezuela in 1995 adopted the policy of Apertura. And their production capacity took off. Of course, it was slammed to a halt when Chavez came into office, but it happened.

Saudi Arabia, everyone said, we ll never get into Saudi Arabia. And we re not there in petroleum, but there are several -- there are now four contracts being negotiated for natural gas to go to Saudi Arabia. And there is a lot of debate. Does that mean that the oil companies are getting their foot in the door for petroleum? And I think you can make an argument either way on that one. But the important point is, if the companies come in and bring money into the natural gas sector, that just frees up resources for the petroleum sector.

Iraq. Things have changed a lot in Iraq in the last few weeks. We re going to have, for sure, foreign investment. Kuwait. Kuwait is still a big question mark, but Kuwait s parliament has been tying itself in pretzels trying to figure out whether it should allow in foreign investment. So far they ve decided not to, but they could.

Russia, Azerbaijin and Kazakhstan. Look at the development that we have in those three countries. If you had told me before 1989 that we would be talking about investment in these three countries at the extent that we have it today, you know, I would have said, well, yeah, maybe, maybe not. I doubt it.

China. China is not a big producer, but in it s refining sector and distribution sector it s beginning to allow in foreign investment.

The other thing that s changed with foreign investment is how do you structure it? And one of the things that I find very interesting is that foreign investment is happening in places where part of the reason it s happening is because the countries and the companies are able to structure deals that are more acceptable to both parties.

If you look at a typical -- so the original investment vehicle was a licensing agreement. Foreign company paid royalties and taxes to the host government, but basically the oil came out of the ground and went to the company. A lot of countries didn t like that. Arguably, that led to the nationalization of several of the OPEC countries producing sectors.

Production shared agreements, this is what we re seeing in Russia, or what we re trying to see in Russia. The other company can book the host reserves and get the oil to cover development costs and a portion of oil over and above the costs, but the oil remains the ownership of the national government.

J.V. This is what basically opened up Venezuela. The host government and the foreign company could both have ownership of the project. The government could hold more than 50 percent, thereby feeling as if it was still in control.

And then the buy backs. This is basically what Iran has done. We basically have a service contract with a foreign company. A foreign company comes in, develops a field, they get paid a fixed fee, essentially. They then go and have a second contract with Iran where the company gets preferential treatment in purchasing the crude.

So it s almost like two parallel contracts. What that does is it lets the country, like Iran, who is very, very concerned about ownership of that oil, the sovereignty of their oil allows them a vehicle for allowing in foreign investment.

Tax laws change. Tax relief. I m sure

Mark knows much more about the petroleum revenue tax than I do. It s a tax on profits from production in the North Sea in the U.K. In the late 80's I think it contributed to the profits -- correct me if I m wrong, Mark, but basically the companies producing in the North Sea had a marginal tax rate on profits of something in the 70 percent range. During the course of the early 90's it was dropped down something closer to the 30, 35, 40 percent range. And as I understand, it s being abolished now. Is that correct?

MR. FINLEY: Well, yes.

MS. EMERSON: Or being removed.

MR. FINLEY: Replaced by something else, of course.

MS. EMERSON: Okay. Spoken as a true BP representative. But the point is, is that in modifying the petroleum revenue tax at the end of the 80's and the early 1990's, the U.K. Government did a lot to spur the boom in the North Sea that happened in the early 90's.

OCS deep water royalty relief. Again, here is the situation where the U.S. Government waived royalties in order to spur development of certain new fields.

The other point I want to make about tax change, this is very, very simply for those of us that follow these things on a day to day basis. This is a very well-known phenomenon. France developed -- has refineries, basically, that were initially designed to maximize gasoline production, but their tax structure favors diesel production, favors diesel demand because it taxes gasoline at a much higher rate than diesel demand. And that s in large part due to the trucking lobbying in France. But here is a situation where consumption -- the impact of consumption tax has changed dramatically towards the end of the 80's, and ultimately, the 1990's.

Okay. Let s move on to industrial regulation and how it changes. And this is something -- this is a very difficult issue to characterize and to summarize, but I ve tried to sort of lump developments together.

And the majority of deregulation that s taking place right now is in Asia. Several of the Asian countries have already deregulated. Obviously, Korea, Taiwan is largely finished, but there are several more that are in the process of deregulating, basically opening up their oil industry more to market forces. And they file it to really two or three categories.

The first category, at the top here, is essentially the net exporters, the countries like Indonesia, actually, there really aren t that many in Asia, are removing subsidies or are looking at removing subsidies. When you remove a subsidy, generally, prices rise and in some cases you will add taxes later. For the most part, this is a very small group. It s not -- there is not very much action there.

The other group is removing import restrictions. Generally speaking, most of the net importers in Asia have had import tariffs on oil imports. And they ve had it in an effort to protect their domestic refining industry. And what they re doing now, really copying Korea and Japan, they re removing the import restrictions, and as that happens the internal prices fall.

But what do they do then, because part of what they were getting from the import tariff was government revenue. Well, they re having, in some cases, to add taxes back onto the price of product, just as Korea and Japan have who have taxes as high as Europe on auto fuels. And then a quick, close brother of the removing of import restrictions has been the removal of price controls, and now we re really talking India and China.

When you remove price controls, which are controls that held prices high, prices fall. But, again, you ve had to add taxes to replace the government receipts. China and India are often held up as the two biggest sources of oil demand going forward.

When anyone talks about resource adequacy, they have to address China and India, because those are the two countries that have the most potential demand growth, and yet these countries are pursuing deregulation along the lines of removing import restrictions, removing price controls, and they re having to add taxes. They are not going to look like the U.S. when they re finished. They re going to look like a hybrid somewhere between the U.S. and Europe.

To summarize, you ve got several of these countries that are going through deregulation. African countries are doing it too, although their consumption is trivial. What they re basically doing is, they re opening their markets up to the price mechanism. Subsidies are being removed, that s raising prices, or import controls are being removed, and that s lowering prices. The end result is something closer to world prices. Chinese prices, petroleum product prices right now are tied to an average of prices in Rotterdam, Singapore and U.S. Gulf Coast. They are essentially exposed to the fluctuations of world prices with some modifications.

What s interesting here is along the way these countries are developing fuel taxes to build roads. The case of India, they re going to finance their strategic reserve with a tax. Result is, it s very hard to see these countries with booming demand growth. It s going to be very hard to have a transportation fuel driven boom.

Okay. In the interest of time, I stole this chart from a German paper, which I can give you all the title of. It s actually -- I think it is actually on EIA website, because I saw it there as well. And if you can see, it s a little hard to read, but basically what it shows is the number of cars per 1,000 inhabitants in Asia. And there is a lot of numbers in the 100, 200, whatever. But here is India, and there is seven cars per

1,000. Good heavens. And here is China, which is eight cars per 1,000 inhabitant.

And this is what everybody looks at and starts drooling about when they talk about booming oil demand. They look at this, and it s kind of like Rockefeller saying, well, if we could get everyone in China to have a kerosene lamp, we ve got it made. Well, now people are saying, well if we could get everybody to drive at least a four -- a two wheel motor vehicle or a four-wheel motor vehicle, we ve got it made. But don t think we re going to get there.

This is also the same German study, and this should be the 2000 chart. For some reason I grabbed the 98 chart. And the only reason I used it is it has what you re seeing here, and you have to take my word for it, is the price at the pump from every country that sells gasoline at the pump. And so there is a couple hundred countries in here.

And what s interesting, and the 2000 chart is the exact same chart, just the number is a little higher because the wholesale price was higher in 2000 than in 98. This line here is the price in Rotterdam, the wholesale price, not the pump price.

And if you look to see where the taxes are, here is Japan and Europe. They re right around here. Here is India right in here. Here is the U.S. This is pump price, so it includes tax. And here is China. And everyone is sort of saying, well, look, China is down here. They re not going here. India is here. They re not going here. They re going to have a market that looks much more like the U.S. And I would argue that they re not because they cannot afford to not impose fairly significant fuel taxes.

There has been a lot of research done by the World Bank on this issue. It s very hard for these countries to collect income tax. It s even harder to collect that. It just -- it s just very difficult to administer. It s difficult to collect. And so, increasingly, there is a feeling that they will have to levy higher and higher fuel taxes because it s easy to collect. The key to this, according to the World Bank, is do it in small increments so then they kind of won t notice.

Okay. That brings me to demand. I ll just include a few demand points here that a little bit more macro here. This chart shows the forecast that IEA s demand for 2010 and 2020. And if you just look at the growth rates, they ve got 1.8, 1.7 percent. Here is the EIA s -- and that was IEA s 2002 forecast. The EIA s 2003 forecast, which is essentially hot off the press, has two percent growth to 2010, and 2.2 from 2010 to 2020.

ESAI, my company, it s a little scary, has a very similar number. Frankly, this bothers me, and I ll tell you why. Because when you do demand forecasts and you build them from the bottom up, so that means you add up Cameroon s -- assumptions on Cameroon s gasoline, diesel, jet, whatever, for every country, it is very hard not to be optimistic because you have to find big events to derail demand growth.

So forecasts of demand, in my opinion, are always biased high. And it may be that forecast supply are always biased low, and that may be why we re all here today. I think all three of these forecasts are wrong, including my own. I think we ll have a very hard time ever getting or sustaining 1.8 percent growth.

I hope you can read this. This is global oil demand from 1970 to 2003. In the 70's it grew at 4.3 percent. I think we had a price chart showing why demand grows so much in this period. In the 80's it grew at .1 percent globally. In the 90's it grew at a whopping 1.3 percent, and in -- since 2000 we re growing at one percent. This is global oil demand. Why are we all forecasting 1.8 percent? Honestly, I don t know. It s an incredible optimism.

Here is another way of looking at it. From 1983 to 2003, this is demand growth in millions of barrels per day per year, and I ve broken out some of the key components. If you look at the little blue square, that s U.S. gasoline, which is impressive that it s even visible on the chart. If you look at the red one, that s European total oil demand. The yellow is a little hard to see. It s China, which has had a couple really big years. And then the pale blue is the rest of Asia. And here you got -- we had some boom years for Korea in here. And then, the purple is the rest of the world.

And in this 20 year period, when arguably we had some pretty interesting things going on in Asia, but also some dips in places like the former Soviet Union, we averaged 950,000 barrels a day demand growth. And that we re saying over the next 20 years we re going to average 1.6 million barrels a day, which is roughly the 1.8 percent. It means that all of these components have to have boom years, 20 of them in a row.

I ve talked a little bit about tax issues in Asia, possibly preventing a transport boom, and a little bit about the need for tax -- fuel taxes in these countries to generate government income. I want to touch base again on energy security issues.

The Asian countries rely on the PG, the Persian Gulf, for 80 percent of their imports of crude oil. This is a well-known thing, but what s interesting to me about this is after the first Gulf War they didn t. This is a change. This has been aggravated in the last 10 years by the fact that China has flipped into being a net importer.

India and China will build strategic reserves, and oil import dependence is a growing problem. More reasons why they are concerned about oil demand growth as well.

Okay. Asia s oil demand. If you look at the barrel, this is a somewhat simplified presentation of demand. 35 to 40 percent of their demand is for middle distillate diesel, diesel kerosene, 15 to 20 percent is gasoline, another 15 to 20 percent is fuel oil, and then the rest is LBG and others.

If you look over time, the big growth number in Asia has been middle distillate. It s grown, and it s had years where it s grown six, seven, eight percent. On average, over the last 10 or 15 years it s been growing at something like four percent for the region. I m not going to quibble with that. Let s say it continues to grow, because it is a GEP and population driven number.

But what about these two components? Can they grow dramatically? And this gets us back to the gasoline issue taxes and the inability to have a transportation driven boom. And then, which we talked a little bit about, I want to just make a comment about fuel oil, which a previous speaker made as well.

Here is fuel oil demand in the last 20 years. The red -- sorry I don t have it labeled. The red bar is the United States. Basically after the Korean revolution, we decided to get out of fuel oil and power generation, and we very successfully did so. The blue bar is Europe, which has more recently decided to shift from fuel oil to natural gas. And then the yellow bar is Asia, whose fuel demand has just stayed very high. It was rising through the 90's and sort of tapered off and sort of flattened out.

And the big question in their demand, again, is in addition to the transportation issue is what about this fuel oil? And a previous speaker commented that they re shifting to natural gas and LNG, and I totally concur, it s hard for them to maintain this kind of demand.

So just to summarize. Developing countries issues of demand restraint, road construction requires fuel taxes. It s a chicken and the egg. If you don t have the taxes, you can t build the roads, you can t have the consumption, then you don t have anything to tax.

We expect more fuel taxes in these countries, not necessarily on the model of Europe, but certainly not on the model of the United States. Asian countries, two in particular, are building strategic reserves, but several of the other Asian countries are beginning to hold mandatory stocks. Certainly not 90 days, but 15, 20, 25 days.

PRESIDING MEMBER BOYD: Crude oil or finished product?

MS. EMERSON: Generally finished products. Obviously, energy security concerns are encouraging substitution of gas and LNG for oil. And then these countries, also, are taking on tougher environmental fuel specifications, nothing like gasoline here, but certainly removing sulfur from fuels.

And then in developed countries, new -- other areas of demand restraint, also mentioned previously, new auto technologies, hybrids, fuel cells. I mean, that s all coming down the pike. They hybrids, Honda claims they re selling more of the hybrid Accord than they anticipated, but there seems to be a demand for the hybrids that s beyond expectations.

Again, we have -- we are still regulating the fuel content. We still have more changes to make in fuel content. Fuel technology, we re finding different kinds of additives. One of the comments made earlier about gas to liquids technology, as a diesel extender I think it has a lot of promise. And then, of course, conservation. We are supposedly improving the conservation to the MPG. To the degree that we go any further than that is probably a political debate.

This brings us back to the non-OPEC, and I agree with both previous speakers. We have a lot of non-OPEC supply coming on in the next 10 years, really dramatic numbers. Again, I m comparing these three forecasts, and, again, they re a little eerie for me. The IEA has a very low increase in non-OPEC supply from 2010 to 2020. It s only .1 percent growth. The EIA is much more optimistic at 1.1 percent, and we re sort of close to the EIA.

But what s interesting, if you take the demand forecasts in the previous charts, and these non-OPEC supply forecasts, you get a pull on OPEC or what we call a call on OPEC. And it s interesting. EIA, again, remember they ve got real low non-OPEC supply but a little higher demand, and they re saying that OPEC s output will rise by seven percent in this second decade. EIA is saying seven percent. We don t think they need to put as much into the market. We re really down at 5.86 percent. These are all doable numbers. There is more than enough oil to meet those targets.

So, I guess in conclusion, oil supplies will last longer than any physical assessment of supply and demand suggests because of all these other factors that surround the market and shape the market. When and if supply concerns were to emerge, I believe the market, with the help of government and industry, will respond quickly.

And that s one thing I don t think -- I m not sure we ve gotten to. What happens? Maybe we re wrong. Maybe we are running out of oil. Can we respond? What are our emergency response or do we need emergency? How much flexibility do we have to respond?

And this is where I think we need to think about forecasts as almost like an early warning system. Are we going to run out of oil in 20, 30, 40, 50 years? By doing these forecasts we re looking. We re trying to get some feeling inside. Is it here? Is it here? This is a gradual problem. It s not tomorrow. It might be 20 years. Personally, I think it s closer to 50. But the marketplace will send early indications.

One of the earliest may, indeed, be the financial market slipping from (inaudible). At some point the financial markets are going to say, what a second. If we re really running out of oil, then I can value that much higher in the future. And I m not talking about five and 10 years strips of long term futures.

And wherever we are in this, we need to think about flexible response. And I think we probably are more capable of dealing with this problem if it really exists than perhaps we give ourselves credit for. We have a tradition of crisis management from the energy security side. We have significant room for conservation, especially in this country.

We are in the trend towards a broader energy mix, again, especially in the U.S. and Europe, but possibly Asia as well. It s pretty uncertain that there will be any kind of transportation boom in Asia. Environmental movement is tightening emissions and fuel specifications. Auto technology is advancing. Fuel technology is advancing.

If there is a problem somewhere in these decades, we have a lot of tools for coping, and these are tools that you can turn on fairly quickly. I think I m done.

So my recommendations, if the California Energy Commission comes about and says, well, we re not sure, I say monitor the 10 to 20 year outlook. Forty year forecasts, frankly, don t really mean anything. They re intellectual exercises. Market analysis in this time frame can be very rigorous. Price mechanism is going to tell us a lot about what s happening in this time frame.

Look for early warning signs. If you re really worried about this problem, identify some early warning signs and then develop a strategy that s incremental and proportional to those early warning signs. I don t think you re going to need to, but if you feel you do, you can take those kind of steps. And I m finished. So, thank you.

PRESIDING MEMBER BOYD: Thank you, very much. Questions, comments?

DR. SMITH: Yeah. You said you did a demand forecast bottom up --

MS. EMERSON: Yes.

DR. SMITH: -- looking at every country. Then you showed a supply forecast that shows continued growth up to 2020. Did you do the same bottom up study for supply as well?

MS. EMERSON: We tried, but it s not the same thing, because to really do a bottom up you d have to do field by field analysis, and there are only certain parts of the world we feel we have the capability to do that kind of thing, like the Gulf of Mexico.

DR. SMITH: Because the presentation I gave this morning was a bottom up study in that --

MS. EMERSON: For ever field in the world?

DR. SMITH: Well, it was -- I haven t got every field, and nobody has that information at all in the whole world. But from looking at trends and country trends, and (inaudible). And I believe that we will peak in terms of supply sometime in the next decade, not in 20, 30, 40 or 50 years.

And I put in different demands there is, and I (inaudible) for about one percent demand growth as a reasonable number, which I was happy to hear that an economist might agree with me. And I see about the middle of the next decade where we will come into a supply --

MS. EMERSON: And you re saying OPEC and non-OPEC together?

DR. SMITH: That s including OPEC and non-OPEC, yes.

MS. EMERSON: I guess my question would be, where do you put -- how low can the reserve to production ratio go in your forecast?

DR. SMITH: Well, I don t even consider reserve to production ratios because the key, I think, is just production, and it s not even resource. I know you had a picture of a barrel with a tap on it and said how long to get an oil barrel. But really the crucial thing is not how big the barrel. It s how big the tap is.

And that is, I think, where the crunch comes. I think we get to a plateau and maybe bubble on the top for a bit. And the problem is getting oil out of the ground in the time available.

MS. EMERSON: So, your concern is, there is not enough capital to put into this problem?

DR. SMITH: No, not capital. Even you could almost put infinite capital. It still won t get out fast enough. I don t think it s physically possible for Saudi Arabia, for instance, to increase their output to the sort of amount they would have to increase by the time the non-OPEC supply starts to decline.

MS. EMERSON: What is the bottleneck?

DR. SMITH: The bottleneck is the way reservoirs produce. I mean, the fact that the vast majority of our oil comes from fields that were discovered in the 1960's and before, we should begin to decline easy oil and precious drop in our reservoir, and so this oil is coming out slower than it was beforehand. So, that, I think, is a real problem.

I mean, of course, there is a problem in investment capital. They need to -- I m sure if they really threw money at the problem they could solve it, but that money won t be available if we re in a supply crunch because --

DR. GAUTIER: Are we in discussion now, or is this a question and answer period?

PRESIDING MEMBER BOYD: It suddenly turned into discussion.

DR. CAVALLO: I have a question.

PRESIDING MEMBER BOYD: Okay. We have a question. Then we ll take a five minute break and then start the panel

DR. CAVALLO: You made -- excuse me. Question.

MS. EMERSON: Sorry. Sorry.

DR. CAVALLO: You made a statement about production. Do your production projections have anything to do with the USGS reserve estimates, or are they based on -- what reserve estimates are they based on?

MS. EMERSON: Well, the way we do it is we have a set of USGS proven reserve numbers. I don t know if it s the latest, greatest set. I know they were presented this morning.

DR. CAVALLO: Yes.

MS. EMERSON: Let s assume they re not that different. And what we do is, we try where we can to do field by field projections, which, obviously, there is only a few countries where we ve been to do that because it s just -- it s an enormous volume of information.

Where we have just national data, we then look at the reserve to production ratios and we sort of say, okay, is this a country that has access to capital? Is this a country that either has access itself through -- or through -- or does it have a foreign investment environment that s going to bring in the Exxons and the BPs and the Shells.

If it has access to capital, then we make assumptions about the degree to which the reserve to production ratio could theoretically decline over a 20 or 30 year period. And we then make an assessment of additions to reserves, which is essentially an historical average, which may be too high, and then generates a view. But that s sort of the technical approach.

The other approach is we look and see what projects are underway, and there are a lot of projects that have a 10 year time horizon where you can say, well, in Angola, this is happening, or you know, the pipeline out of Chad is actually up and running this summer. And you begin to look at these projects and you can begin to use anecdotal evidence to work your technical analysis, at least in your first 10 to 15 years.

MS. PHILLIPS: You, on your last slide, you had something about watch for early -- or define what early warning signs should be. Could you give some suggestions of what kind of things you re thinking about?

MS. EMERSON: Well, I don t think you

need to look for early warning signs at this point, but if -- but I realize this is also a political decision because this is a sensitive issue. Since none of us can come out here and definitively say, this is when we re going to run out, or we re never going to run out, it seems to me that we should try to think about early warning signs.

To my mind, an early warning sign would probably -- probably come from the producing and or the financial markets first. So the producing industry with financial markets. And it would be a question of access to capital. It s very hard to say. I mean, I d have to sit down and think through what the best early warning signs are.

I mean, I don t think you can sort of say, well, if the price hits 35 dollars, that s our early warning sign, because there are so many other factors that could be moving the price. So, I don t really have a good answer for you on that. It s something to think about.

PRESIDING MEMBER BOYD: Okay. Five minute break, which will turn into ten, and then we ll start with the panel discussion.

(Off the record.)

PRESIDING MEMBER BOYD: Chairman keys, would you like to make some introductory remarks, and then we ll turn it over to Chuck Mizutani to kind of do the coaching of the questions.

CHAIRMAN KEESE: Well, perhaps Mr. Mizutani has it all laid out exactly, but what I would like to do is put in context here that we didn t discuss too much at the front end this morning, and that is, what we are charged with doing, and who we are.

This is the Energy Commission who is trying to put together this report. We are doing it with some of our cohorts who are in the audience. The other agencies involved in California, some of whom are direct energy agencies and some of whom are in the broader category.

And we re now charged with this integrated energy report that is meant to be a policy beacon, I guess, for California that all agencies will follow so we will have coordinated energy policies.

I m really pleased to hear the different presentations today, and even though we re talking about one subject, that where you would think people were walking locked in step, we have heard a diverse number of approaches to this same issue, and enough commonality among the numbers that we re not -- we re not disagreeing wildly in our starting point. There are different views of where the future is.

But if California and its agencies are going to seek out a common thread to moving forward, this is the process in which we re going to take a shot at it. I m sure as we do this biannually here, we ll get better every two years, and perhaps we ll get to a point where can establish what the markers are down the line that should give us concern.

In our opening shot, I think we do have to say something pretty solid in this area, that it is -- it s a major building block to whatever the policy should be. So I look forward to a discussion here, and perhaps you have all the questions, Chuck, so that you can just get the answers that this committee needs to move forward with.

MR. MIZUTANI: Well, first thing, Mr. Chairman, I was just sort of scratching my head for the last half a day when asking the question, what is the question? But perhaps what I ve sort of come away with right now in terms of the various presentation is it appears as if there is sort of presentations that sort of focus on two separate time frames. I think one is for the near term and the other is really the longer term.

In terms of, I think, the morning presentations, they seemed to be focusing really on the longer term, and in the afternoon, the sessions seemed to be focused on the near term, but there doesn t seem to be much of an overlap. And so the question still, I guess remains in my mind is whether or not we are -- we will see a point at which oil production will peak, regardless of when it is. But I guess the question is, is there a general consensus that oil resources will peak in the future?

Perhaps I can start, maybe, just down the row and get some responses.

DR. GAUTIER: As you know, I m a geologist, and I see oil and gas as being molecules that are distributed in the Earth s crust, you know, like anything else. But from my point of view, very clearly, the resource in the ground is enormous compared to the reserves that are being produced. Truly enormous.

And so it ends up -- you know, I hate -- I hate agreeing with and cavorting with economists. You know, it s an awful thing. But, in fact, I find myself, having looked at oil and gas resources for my career of 25 or 30 years here, I am continually amazed that I can t tell you how much there is in the ground. What I can tell you is what results when humans work on the resource base.

So, for example, I ve recently been working on the world energy project, which is this enormous view. At the same time I ve been running a project looking at growth of reserves in the San Joaquin Basin in California. Now the San Joaquin Basin, you know, is just down here south a ways, and it s been under production since well before the turn of the previous century. It s been on production since the 1800's.

Today if you press the operators down there, I mean, they are really only pouring money into a few fields, and it looks like they don t even do production. They just get money that flows right out of the ground and into the bank. You know, it isn t -- nobody explores the (inaudible) because all you do is invest technology in these existing accumulations and they get enormous, enormous production.

So if you look, say, at production in California as a state you d say, well, it went through a peak, and you could really demonstrate that. But the question of exactly why did it peak and does that peak reflect a hard edge to the absolute geological supply, I d have to say, well, no, it doesn t. Not from what I can see.

We don t produce offshore. The offshore production has declined because you re really not -- you re really not doing much investment out there because people in Santa Monica Bay and the Santa Barbara channel don t want to look at a bunch of platforms out there. It s not -- you know, it s not being intensely developed in LA Basin and Ventura Basin because it s all covered with houses and it s a real pain to try to do work down there.

In the San Joaquin Basin, as I say, these companies are not exploring for new fields. They are just trying to tap and watching the money flow out of these big old fields. So, for example, this field I mentioned today, Midway

Sunset.

When I was born they began keeping careful records there, and at that point the estimated ultimately recoverable oil at Midway Sunset stood at about 800 million barrels. Now whatever it is, 20,000 wells later, estimated ultimate recovery at Midway Sunset is in excess of 3,500 million barrels, and there are production plans out decades into the future.

And if I press the geologist who work on it, I say, well, do you know what the absolute original oil in place is for the Midway Sunset structure? Well, no. Who cares? What we care about is we re imaging this reservoir on 3D or 4D seismic, and we re going to send through these amazing drill strings through there, and they re producing layers of rock that are 10 -- you know, they re 10 meters thick, and they re getting 90 percent of the oil back, and they re making a hell of a lot of money doing it, and that s all they care. That s really all they care.

And they re comparing, what do I do with the money I invest at this ancient oil field in California versus what would it do for me in offshore West Africa or the North Sea or Sumatra o wherever it is.

So getting back to your question, clearly, someday, what I call conventional oil is going to reach a peak, but will it be geologically limited? I really doubt it. And will anybody care? I really -- I really kind of doubt it. And one more remark and then I ll shut up on this.

A couple of years ago, I mentioned this at lunch, I was giving a talk on this world energy project in Copenhagen, where there is a firmly held belief that we are in imminent danger of running out of oil. In three years or something we re going to hit a hard supply edge, after which we go off the cliff, and you better be running on windmills.

And there was a woman in the back, a wonderful woman who asked me, Dr. Gautier, please tell me, in your opinion, what will be the price of the final barrel of oil produced? And I never answered it. I kind of regret it in retrospect. But it s a wonderful question.

And I think it sort of frames your view of the world, because, I guess, if you asked me, the answer would be that last barrel would probably be given away free because we will have moved on with technology and other stuff and it will have no value whatsoever.

So when my colleagues may say it will be a cost of many human lives and zillions of dollars, but it s a fundamentally different view of the universe.

DR. SMITH: Well, I certainly agree with the last barrel of oil wouldn t cost anything. And the last barrel probably produced it may be in 250 years time, because I think using the term running out of oil is an erroneous term. The world will never run out of oil. We ll be producing oil for as long as we need it.

But it s just -- the question is how much. And I certainly, as you saw from my presentation, I certainly do believe that we will reach a peak, and I think it will be sooner rather than later, probably sometime in the next decade, maybe early in the one after that.

And this is based on data from the whole world. And, really, I think the crucial fact about the fact that we will reach a peak is the fact that take, for example, the U.S. The U.S. has reached a peak, and the U.S. is just a country in the world. Sixty countries in this world have reached a peak and are declining.

And there is really no conceivable way that they will be able to get back to the peak they were at before. They may slow decline. They may have little subpeaks on their decline curve because of new oil they discover. They will never get back to that peak. And if you look at the whole -- the globe totally, it seems to me common sense that the globe is going to end up in the same way, however much technology is put into it, however much imaginative geology or whatever it put into to.

So, really, I think it s not a question of if but when, and that I think is where (inaudible) should lie.

CHAIRMAN KEESE: Let me ask a question. Are you accepting the $20 target price for current drilling and development activities?

DR. SMITH: I have -- I mean, the analysis I have done is not dependent on price at all. I don t -- I think that price and supply are not really related.

CHAIRMAN KEESE: So if it goes to $30 --

DR. SMITH: I -- $30, then there would be -- potentially there would be more drilling, potentially there would be more discoveries. But I don t think the impact in a significant way on when -- on this peak or when it occurs. The only thing that would impact on the peak is demand, and clearly, price will control the market.

MS. EMERSON: I think the last barrel is going to be sold on ebay, and I think it s going to be very valuable.

PRESIDING MEMBER BOYD: It s kind of like that (inaudible).

MS. EMERSON: Well, I guess the way I would answer that question is I see a series of peaks. Lots and lots and lots and lots of peaks going on as far as we can see. And every time we get to the downslope of the peak, the price starts going back up, then the money comes in, and we ll create the second peak. So I see it as lots and lots of peaks, geographically all over the place. So with that way the future could go on for certainly more than 50 years.

DR. CAVALLO: Well, I based my work on the USGS estimates. I think we should believe them. I think -- I do agree that the term running out of oil is calculated to cause panic, and I don t think that s a very constructive way of looking at the problem. But, as others have pointed out, the United States has peaked, the U.K. has peaked and Egypt has peaked.

Countries around the world do peak or plateau. I think we can look at that as a signal for what is going on out there. But, well, so I think my analysis, I ll stand behind my analysis.

What I would -- I d also stand by my suggestion for an alternative policy. If you want to handle problems with oil, whether they be environmental or resource constraints in the not near future but intermediate future, I think my suggestion of surcharges and rebates is a reasonable way to approach the problem, to get people to think about -- force people to think about what they re doing by consuming gas in SUV s or big cars. And it s -- it won t penalize them. They can make the choice, but it makes them think hard about what they re doing.

So that would be my suggestion is to look at something like that as a way of handling this problem and handling problems like congestion and pollution.

CHAIRMAN KEESE: Kathryn?

MS. PHILLIPS: From what I gathered

today is that we may peak and we may not peak, we have peaked and we haven t peaked. But to me it s almost -- the question is almost not the right one because the great thing about California is it s not afraid to take a leadership role. We recognize -- there are some agencies, at least, and certainly a certain amount of the public has recognized that we have problems because of our dependence on oil products and how we use them and what the results -- the environmental results are.

Not all of us are anxious to make our problem the problems of other countries. We don t -- we don t necessarily feel that it s -- that we d like to be more self-sufficient. We d like to not transfer our environmental problems to other countries.

Given all of that, I think the state -- that the opportunity is there to figure out now while there is at least some wiggle room, even if you believe that we ve peaked and we re on the downhill slide, we have some wiggle room and it seems to be that now is the time for the state to figure out what -- what can we do to reduce our dependence on oil, and I think the state is taking some steps in that direction.

But, of course, it s going to have to come from more than just the state. We re going to have to figure out ways to encourage the general public, and we re also going to have to figure out ways to make sure that the oil producers are paying some of the costs that they ve been able to get away without paying, and I m thinking in terms of environmental costs.

MR. FINLEY: First, I guess, I d say thanks again for the invitation to speak here. I guess for me the answer is going to depend on what the question is. I mean, the -- if the question is energy security and the answer is diversity of supply and, you know, strategic reserve in case of disruptions, which, you know, the federal government has, and other countries already have, and increasingly developing countries are seeking to build, and flexibility of demand.

If the question is environmental in nature, then obviously, you know, any solid economic policy would say that the price should reflect the true cost to society.

And so once that s -- what I m struggling with is, you know, what you want out of this. I mean, what s the question that is under penning today s session? I mean, turning literally to the question of long term supplies, I guess I would say I would agree with Sarah. The last barrel will be sold on ebay, and my elaboration will be that it will be sold to a museum for a collector s item because the world is going to run out of demand before it runs out of supply.

PRESIDING MEMBER BOYD: It will be sold to a rich person who will take a tax deduction and give to a museum.

MR. FINLEY: Well, see, there is tax policy. Again, it faces it s relevance. I mean, I think what I took away from Don s presentation is that not only is the resource base enormous, it is elastic. I mean, it s not elastic. That s the wrong word. It has a ratchet effect to it. It only goes one direction. It grows. And it grows as technology expands our ability to reach it, and as various places around the world upon up their economies to the technology and the capital that can be employed in the search of it.

And we definitely think of -- we don t think of the world s energy resources in terms of being a fixed pool, that that s all there is and then there isn t anymore. We think of it in terms of a supply. Like any commodity, as having a supply curve that responds to changes in price and demand in technology and government policy.

Too, I was struck by Dr. Smith s comment that his analysis is independent of price because he s an economist. To me, price is the only thing that matters. And, I mean, again, the question of, you know, what is the right price and what ought to be reflected in it is a separate issue, but, to me, the whole basis for the USGS work is current technology, current prices, here is what is recoverable, here is what we think could be found.

If you had a higher price in the future, which is what you would get if you started to move into a more scare environment, then you would bring more technology to bear and you would expose more of that resource pyramid that he ended his presentation with.

The final point I would make is that the price of oil is not going to get above the price of competing fuels. I mean, right now you can drill down through 10,000 feet of water, 20,000 feet of rock, bring it up to the surface, refine it, give the government a 50 percent per gallon tax, and still sell it at a profit in this country at about 50 a gallon. You know, you can t buy bottled water for that.

The reason why we use so much is because it s cheap compared to everything else. We already see when the price of oil gets out of line with the price of natural gas, people who have the ability to do so burn natural gas instead, or they burn coal instead.

So there is going to be a ceiling on the price of oil no matter what the resource base for the oil market is because it s going to be set by competition with natural gas, and if it moves beyond that it will be set in terms of competition with renewables. The reason why you don t see a bigger share for those right now is because they don t complete on a cost basis.

If we were to ever get to a point of true scarcity in the oil market, you would get that interfuel competition in a hurry. And I think one of the lessons of history is that the marketplace reacts with awesome speed and power when it s given the right set of circumstances.

I mean, Saudi oil production when from

11 million barrels a day in 1980 to three million barrels a day in 1985 because world oil demand evaporated in five years. And that wasn t because the Saudi Arabia was running out of oil. It was because people said, all right, I m going to drive something else.

And so, you know, given the right incentives in the marketplace, the market -- the ability to adjust to these changing situations to perceive scarcity will -- will mean that we never need to worry about the resource constraint, or at least not, you know, essentially, the degree that I ve heard presented here today.

MR. ESKEW: Mr. Chairman, I m not sure I remember the question anymore.

MR. FINLEY: Sorry. Sorry.

MR. ESKEW: If the question is will oil peak, I don t want to sound like Bill Clinton, but the answer is, you know, it depends on what you mean by oil and what you mean by peak. And if you mean world conventional oil peak because of hard resource limitations, my answer is, probably not. It might, but probably not.

And, again, if it ever does, it s going to be a non-event as far as it will be of historical interest more than an economic calamity. And the reason is that the production of other sources of energy that compete and can supplant conventional crude oil production as well as other ways to consume energy, that we don t even have any idea now what they re going to be. Those were -- the growth in those, both the demand side and the production side, are going to make the peak of conventional crude oil production, again, an issue of historical interest more than economic interest.

PRESIDING MEMBER BOYD: Let me --

MR. ESKEW: If we did believe -- I m sorry. I ll just go ahead and finish. If we did believe that it were imminent, then I would certainly compare that it s an issue that we obviously need to address, but unlike the consensus here, at least on the economists side of the table, is that, you know, it s not staring us in the face.

PRESIDING MEMBER BOYD: Let me share with you the dilemma of Commissioner Keese and myself, and that is to worry about the future of the nation of the State of California, vis a vis the world, selfishly. And, you know, we re -- as the world s fifth largest economy, were we a nation we would probably be debating our own strategic fuels reserve and playing on the world scale a lot differently, but like it or not, we are part of the United States, and there are times when we don t like it.

In any event, so we find ourselves somewhat of an island, and for reasons that are hard to explain when you look at energy in general, I mean, maybe we re at fault for the electricity crisis which scared the financial community away from energy for a while in total, all forms of energy. Maybe the ripple, maybe that will go away and we ll come back to some normalcy.

But we had a lot of trouble getting refined product into the state, so last week we were debating the question of a strategic fuels reserve for finished product, not for crude oil, and what have you, and that remains to be seen. But California, also, is kind of on the cutting edge of things historically, and we like to think, those of us who are multiple generationed here, and we like to think that cutting edge, you know, particularly environmental.

I will confess to this audience that at

one time in my life I was the executive director of the Air Board here for 15 years, so a lot of these clean burning fuels and all that stuff were on my watch, and we like to think that an environmental concern leads to a lot of positive and progressive things that happened to help our environment. So, to me, cleaner burning fuels will sweep the world in somebody s lifetime, more or less.

Every developing economy wants a lot of things, including mobility, and we think a car or something like a car, but they also want a better quality of life. And so what starts you off and goes a lot of other places, and as I understand it, the cleaner the fuel gets, the less you get out of a barrel of crude oil, because it s more exotic to make and it puts more pressure on a barrel of crude and so on and so forth.

So that s one of those externalities that will put some pressure on it, but it sounds to me like -- I kind of came into this meeting thinking that, you know, there is a probably a lot of crude oil out there, and it will probably last longer than I ll ever care, or even a couple of generations of my family who follow me will care.

But there are other things that seem to create problems for Californians. We do seem to have high prices well beyond what the environment, incremental cost is. We are somewhat of an island. We are more interested in pushing efficiency and what have you, and many of you addressed efficiency as something that happens and just happens, perhaps, spontaneously. I, for one, don t think it does happen spontaneously in some cases unless it s given a push. And this nation isn t interesting in pushing it right now, but the State of California probably is more interested in pushing it.

So we have those kinds of dilemma s facing us, and it s really hard to figure out, you know, where we should be going next. So I would just invite some discussion from any or all of you about things California can do to seemingly address -- or to address its seemingly unique problems.

People aren t anxious at the moment to build natural gas pipelines into California, and we re very worried about, as we discussed this morning, natural gas. People aren t expanding refineries in California. In fact, until last

Thursday in this room for a decade nobody had ever said they were even interested in increasing refining capacity in the state. Sometimes you blame it on environmental rules. I don t accept that, but nonetheless, we do have kind of a transportation fuel dilemma.

So we look at things like security through diversity and gas to liquids and other alternatives. And I m just wondering if any of you have any views on that or, you know, what it is that might attract something else to the state that addresses what we see as an oncoming transportation fuel dilemma. Open to the floor.

MS. EMERSON: Well, speaking as not a California resident, you know, when we look at you guys, I mean, obviously, California is a -- has been a trend setter on environmental controls and fuel specifications. But the other reputation you ve got is the, you know, not in my backyard. And I think that s part of the natural gas crisis certainly had something to do with that -- the power generation crisis.

And I guess what I m a little confused by, if you can t expand the refineries because nobody wants (inaudible) and if you can t add probably any more generation, and you ve got issues with pipelines, it seems to me that the decision is really on the consumption side. That that really is what you re moving towards, because there isn t going to be an industrial decision -- an industrial solution.

PRESIDING MEMBER BOYD: Well, we ve proven we can build generation if it reaches a crisis point, and have done a pretty good job of that.

CHAIRMAN KEESE: And we ve proved we can pay 40 cents more per gallon for gasoline than anyone else in the country.

MS. EMERSON: And see, that, to me, in my mind is a -- I mean, you re willing to do that. The rest of the country isn t.

CHAIRMAN KEESE: Intentionally or not, we re willing to do that.

MS. EMERSON: That s unusual.

MR. FINLEY: A couple of thoughts. It was raised a couple of times here, the questions about the financial shape of, you know, things that affected financial decision making and business investment decisions. But business crave more than anything else when it comes to investment on decision making predictability and certainty.

And so anything that could be done to increase the confidence of the business community in the state s staying power, you know, like I said, and the predictability and certainty of the policy and regulatory regime, would lower the perceived costs of doing business in the state. It seems to me, and as Sarah mentioned, and specifically regarding the question, the issue is the full specifications here and the lack of -- the lack of substitutes around the world.

I mean, there are very few places that have these fuel standards, and so, you know, if you run into a supply problem with one of the very few people who are configured to supply gasoline, you can t do just what the rest of the country did when, for example, Venezuela went offline, which is to say, suck it in from anywhere else in the world because it s a global marketplace and everything is fungible. You know, that doesn t apply to the same degree here.

So anything that could be done to move those specifications to make them more widely accepted elsewhere or to move the specifications here into a place that is more readily substituted elsewhere in the world would be helpful.

You mentioned natural gas. My thought there is that, you know, as we heard today the natural gas resource around the world, and this is a general comment for the country and North America at large, the natural gas resource around the world is relatively useful compared to the oil resource base. The trick is -- the problem is that the North American market isn t connected with the rest of the world in terms of a natural gas marketplace right now.

The obvious say to make that connection is to build more regasification terminals for liquefying natural gas, and, you know, hope that -- expect that there will be a marketplace to supply that. Now, that involves tradeoffs. I mean, I understand that those -- setting those are very controversial. Certainly --

CHAIRMAN KEESE: They always have been.

MR. FINLEY: What was that?

CHAIRMAN KEESE: They always have been.

MR. FINLEY: Yeah. And that s sort of been our experience elsewhere in the United States as well. But if the question is, do you want to see a natural gas market that continues to repeat this boom bust cycle and that has prices, you know, generally much higher than they ve historically been, or do I tap into a world market where the costs are considerably lower? That s -- policy making is all about trade offs.

CHAIRMAN KEESE: I think you were on the side that suggested that we really shouldn t be looking -- that one of the reasons we don t have to consider whether there is a cliff or not is that we should be looking at the 10 year -- we should be looking out about 10 years. I know people were saying 2010 or 10 years. And at that point we have no idea what it will be beyond that.

MR. FINLEY: Right.

CHAIRMAN KEESE: So if we re going to say we re going to hit a cliff in 20 years, don t even worry about that. Not because it isn t a cliff, although I hear that too, but because you don t know where you will be in 10 years. And as you approach that, that s when you would start thinking about anything further out. So that I guess your advice to us as a committee, am I correct in capsulizing it by saying that we shouldn t be looking beyond 10 years?

MR. FINLEY: No, I m sorry. I didn t mean to give that impression at all. I think it s absolutely in your job to be worrying along a much longer time horizon than that. What I was saying is that my ability as an oil market analyst to foresee oil market trends, you know, 10 years is kind of the window in my crystal ball. And what I was hoping, the point I was trying to convey was that the lessons that I can generalize over, you know, the 10 year window where my crystal ball has some degree of clarity can easily be extended well beyond that.

And so, I was hoping to illustrate with a great degree of confidence what I thought would happen through the end of the decade, and then say and I don t see that these patterns and developments are going to be derailed beyond that. Admittedly, it s very difficult to see further down the road.

CHAIRMAN KEESE: And in looking at your analogy, which I happen to be very much in agree with, but I think what I heard you saying, if we re going to have LNG terminals on the West Coast, it s going to take us five or six years to get them. If they re going to come in they re going to be financed on a 20 or 30 year cycle.

So if we don t see a need for natural gas or an ability to get natural gas on the West Coast 25 years from now, that s not a viable project. And between cutting it close and saying it will last for 25 years and not beyond is probably not going to bring the financial markets either. So we re going to have to say we do see that we re unlimited supply of LNG around the world for some extended period of time.

MR. FINLEY: We have a deposit in Eastern Indonesia that would be happy to look at selling on a long term basis to California for the right price, of course. But we re certainly confident that the resource base is substantially sufficient to meet that demand, and that --

CHAIRMAN KEESE: And I guess I jumped into the question, is that the time period we should be thinking of as well? Should we be looking at 20 or 25 years?

MS. EMERSON: I think maybe you re referring to one of my concluding slides as well, and what I suggested is the focus on trying to understand what s going to happen should be on that 10 to 20 year period. Let s call it zero to

20, in large part because you can t really know anything in the period after that. There is so many intangibles. There is so many things you cannot quantify that it becomes much more of an intellectual exercise.

So know what you can now was the recommendation I was making. And in that time frame, in zero to 20 years, you can begin to make suggestions about LNG. I mean, frankly, I don t think LNG is a panacea, because the high capital costs are a problem. You can only make so many of these receiving terminals, even in a 20 year time frame, although I think there is creative ways to finance them.

So that was the point about the time horizon. And my feeling is that if you have a sense of what s going to happen in the next 20 years, and the focus is there, and you begin to see the early warning signs, something is not -- we re not going to have enough natural gas or we re not going to have enough CARBOB or whatever, then I think you can begin to take steps very quickly. I don t think you have to have a 10 year lead time on every policy. I think you ve shown that as a state on the lead time on some of the policies you ve stepped into.

But I think I want to go back to the other -- the original point. I don t think you re going to find an industrial solution. If you really want to move forward on reducing oil import dependence and things like that, it s going to be a demand side solution.

CHAIRMAN KEESE: I think that may have been what the Chairman was fishing for.

PRESIDING MEMBER BOYD: Well, and the question in my mind is, do you wait for efficiency or do you force efficiency. As those who know me in the audience come from a school that forced technology or forced efficiency because California couldn t wait for the standard market to bring it.

But in light of the arguments of, you know, it s so far in the future and we can t see that far that oil is available, it s hard to convince the general public, you know, that we really do need to start making some additional shifts away from the conventional way we ve been approaching things. And California, historically, as been able to do it by tying it to air quality, and I guess we ll still have to do that.

Every time there is an energy glitch,

Californians are people that generally get interested in doing something about energy, but the price comes back down like it is right now, and they forget. So for years in my air agency in this energy age we worked as partners, but usually the energy people get in the front of the line and then energy crisis will go away real quick and get in line behind air quality and pull the energy issue along. And that s just what we re going to have to keep doing.

But until the world starts pricing the externalities of the environmental costs into the costs of oil, getting oil, bringing oil to the marketplace, California finds itself in front of that line and having to slog it s way through the jungle of convincing publics and politicians and everyone else that change is -- you know, change is the right thing to do.

MS. EMERSON: Could I just ask a question and play the devil s advocate? I mean, I could certainly see the desire to promote high quality air quality.

PRESIDING MEMBER BOYD: Right.

MS. EMERSON: So moving forward with zero emission vehicles, making tighter and tighter field specifications, I think those are admirable, noble objectives for a state of this size. What s wrong with oil import dependence? Tell me, really, what s wrong?

CHAIRMAN KEESE: I d say it comes from one source.

MS. EMERSON: But it doesn t. It comes from --

CHAIRMAN KEESE: If what -- I recognize that if it s under 40 percent maybe that s the marker. Maybe when it gets to 60 percent you re vulnerable. And maybe you can afford to take the hit that happens when somebody takes the price from $20 -- I felt for 30 years that Saudi Arabia has their hand on the ratchet, and they can put whatever price they want.

But let s say five years from now they take if from 20 to 35. Can the world economy take that hit? How long can they take it for? How long will it take for them to adjust?

MS. EMERSON: Sure, because you have 106 producing countries. The capital will suddenly flood into all the other countries that have this enormous resource. Saudi Arabia, I mean, yeah, Saudi Arabia has got a lot of power. I m not saying they don t. But they can t elevate prices and hold them there. They can contribute to volatility.

CHAIRMAN KEESE: It s how long they can hold them is, I guess -- and it s not to their benefit either.

MS. EMERSON: It s not to their benefit.

MR. ESKEW: Just as the early 80's show, OPEC could hold a price higher than the market needed it to be, but only for so long and at a huge cost to themselves. And I think that s going to be true forever. As a couple of people alluded to, the security doesn t come necessarily through doing everything yourself.

Security comes through diversification and reduction of your role relative to any one particular source or supply. And, you know, the things that California can do to enhance security through diversification are sure steps to enhance the capability of the private companies, primarily, who are going to invest in energy supply projects.

And the key element that a government can do is to -- I don t think it s the role of the government to underwrite or subsidize the economics projects that the shareholders undertake, but what a government can do is to not add additional layers of risk to those projects that the market doesn t crate.

Companies are very good at making decisions about what s the appropriate level of risk, what s an appropriate level of return for the risk of a project. When you throw on top of that a risk of, you know, having to go through 100 different citizens review boards and the rest of the regulatory apparatus that, you know, I m not -- there are legitimate concerns that need to be addressed, but there also are mechanisms to address them that create a lot of timing risk, a lot of just an approval risk. It makes it very difficult for companies to complete projects.

And the other issue to come up was this issue of refining capacity in California. And, you know, certainly one of the -- you know, when you look at investment patterns by oil refiners, as in any other industry, the amount of money that people with capital, the people who are willing to invest in their facilities is -- has a link to the amount of profit that those facilities make.

And when you have a long period of time, such as (inaudible) three CARB diesel sequence, there is a lot of capital that was required to be planned into those facilities just to stay in business just to make those regulations. And that does crowd out capital that may have otherwise gone into capacity expansion.

MS. PHILLIPS: Although, one of the interesting things is that even though we have fewer refineries than we had in the early 70's, and we are operating at greater capacity, we are producing more oil because of improved efficiencies, I mean, more finished product because of improved efficiencies at a lot of it s refineries.

PRESIDING MEMBER BOYD: Let me answer the question that was directed at me. I don t see anything wrong with import oil dependence. It doesn t squeeze out in California into more transportation fuels, which is somewhere along the lines with what s been discussed here.

Interestingly enough, the issue of permitting in California was debated a lot last week as well, just so you know that point, and I think a lot of us see a need to improve the permitting process. And, also, not in my backyard is a dilemma that the state continues to deal with and will continue to deal with in whatever way it can. But it will -- you know, it s not going to back off on the environmental requirements because they re predicated on as of yet unmet public health goals. So it s just something the rest of the world will have to look at over the course of trying to follow the same kind of paths we do.

In any event, I guess I went through the issue on the table, if I have all the answers. I m still scratching my head a little bit. Chuck, we took over our panel. Did you have another question you wanted to get answered?

MR. MIZUTANI: I suppose another question is -- I think the question of, you know, what you addressed, why should California care, I think, really, why should California care is if there is something out in the world market -- oil market that will affect -- adversely affect California, we care.

And perhaps that s the other question is in terms of the world oil market, what are those -- are there things that we should sort of track or be aware of in terms of key drivers that could affect California in the area of the world oil markets.

DR. SMITH: If California is going to rely on this huge resource of oil outside of -- the countries outside, I think you re making a big mistake in becoming import dependent because I do -- I personally do not believe there is this huge resource. And I m not alone in this. It s certainly in Europe. I mean, I m surprised to hear BP, because the geologists in BP tend to follow my view, certainly do in London. Like Francis Harper, who is head of resource assessment, he s generally of the view.

But there is not a vast resource, and the USGS have somewhat overdone the potential for additional resources. I don t know if you speak to BP about --

MR. FINLEY: Would you like me to --

DR. SMITH: Yes.

MR. FINLEY: Yeah, absolutely. We have ongoing discussions. In an organization of 100,000 people you re bound to have people who hold different viewpoints. I mean, I would say that the view of the senior management is at least to the extent that I m aware of is that, you know, as far out as we can see we don t -- you know, in the next 10 to 20 and beyond years, we don t perceive an imminent peak in non-OPEC production. And beyond that, the question is, will human ingenuity continue to expose the deeper parts of that resource pyramid are not hard to tell. And so that s kind of the thinking.

And, you know, we are always worrying about what s next, what s the next big play, where is that next great provence going to come from, because significant amounts of R&D money go into trying to anticipate those and be a leader in them. You know, it --

DR. SMITH: So, where is the next big supply?

MR. FINLEY: Well, that s the research project we ve just been tasked with. So, you know, maybe in a couple years we ll be able to come back and speak to our outlook through 2020 instead of 2010.

DR. SMITH: In my discussions with your BP geologists --

MR. FINLEY: Right.

DR. SMITH: -- I don t see one at the moment.

MR. FINLEY: Yeah. In my experience

having worked on energy markets and worked with geologists for 20 years, this is not a new dynamic. This has been, at least in my experience working as a federal government economist before joining BP, the exact same dynamic played out time and again. You know, this is what we can see now. This is what we know. This is what we can prove.

And then five years later some innovation comes along that you haven t expected, and it s like, okay, well, okay now I ll extend the frontier up to here but this is really all I can see right now and I can t, you know -- I can t make a scientific judgment about, you know, with any confidence about what s beyond that until the next innovation comes along.

DR. SMITH:: In my experience that hasn t -- I haven t seen that. I mean, like, for example, deep water is a sort of panacea that people present, but I don t think it s different as all that. But deep water has been talked about and analyzed certainly since I started working as a geologist 20 years ago. And so it s not really new, deep water. It s just new because we have the technology to develop it. But the concept of it was known about 20 years ago.

And so I have a difficulty in envisioning a concept that s learned about now that we will be developing new technology, because I think, generally, geologists are very, very -- have been very good at their job and they ve explored everywhere and found all the big things. And most of the oil that we are producing right now comes from the big things that were discovered in the 60's and before.

DR. GAUTIER: I was hired in the 70's at Mobil, and at the USGS there was a widespread acceptance of the idea that we would be looking at $100 oil within a very short period of time because we knew for sure that there simply was not sufficient oil out there to keep the price down. And we have been surprised ever since.

The idea of looking at the -- forgive me on this reserve growth thing, but the idea of looking at sizes of fields that have been found through time, and then you show the declining size through time -- and, of course, some of it may very well be as you say. It is easier to find big fields that are plump and can stand these big structures that we ve found.

As I said earlier, we don t know how

much oil is in them, really, and this declining size, at least in part, it s like when we went out here to Sacramento, and we measured the diameters of trees out here and attached them to the unit in which they were found. Well, you know, you d see that the trees planted in 1960 are, indeed, larger than the trees planted in 1990. So one conclusion could be that the trees are just getting smaller and we re facing a wood shortage.

But then a possibility is that people apply technology into those discoveries, into those trees. The trees have indeed grown, and that s, at least part of it.

We look -- for example, we just did a study for an unnamed intelligence agency of Iraq. And, you know, I don t know why they wanted -- I don t know why they cared about Iraq. I have no idea, but we dug up -- we were given and looked at a whole bunch of really kind of secret data, and we looked at everything we could pull together.

And Iraq is sitting there with the reserves to production that, I don t know, it s ridiculous. It s like a hundred -- you know, a hundred or something, the RP ratio. And yet when we look at both the undiscovered resources and the state of the technology there, I mean, it s this technology that was put in decades ago.

It s been ignored. Nobody s invested in it. It s -- it has been neglected, and it looks to me like the biggest threat in the world right now is that something is going to pump all this money in there, and soon the price is going to collapse because you could drive the price down almost without limit. I mean, that s how it looks to us. You could be looking at it a country there that produces like Saudi Arabia.

And I don t know that that s the case, but surely there are situations like this case with Midway Sunset. We look around the world, we see fields with 41 billion barrel, we think, of oil in place. They ve got reserves of a few billion barrels, and they ve got 500 wells in the whole field. And I look at this trifling little Midway Sunset down there, which now I see with cumulative, you know, estimate ultimate of 3.5 billion.

And I admit, that s not a little field, but by world standards, it ain t big, and the 28,000 wells and no limit to where the production is going to end up, it makes you think that maybe if somebody went into Saudi Arabia and Baku and Iraq and Iran and all these places that have been undercapitalized for decades with these clever -- these clever Bakersfieldian techniques, you know, that a little growth would be a huge surprise there.

If you look around the world there are indeed places that are not explored. The entire Arctic, out of 20 or 30 some provences in the Arctic, most of them we didn t even assess. We didn t even look at them because they re off the screen because there is ice, you know, and there is environmental issues.

And so there are -- there are whole geologic provences up there that are as big as the State of Alaska. I mean, those are full of sedimentary rocks. There isn t a well in them. There is not a single well in them. And you can -- I could probably show you five provences around the Arctic that we haven t a clue. There might be nothing, but there might be huge amounts of oil. We just don t know.

I think the question comes to aesthetics and ethics and kind of what it is you want your society to be and do. I mean, in all the arguments we ve heard from Kathryn, you know, when I grew up in California in the early 50's, maybe that would have been a great time to say, maybe we don t want this thing to sprawl all the way to Bakersfield, all the way from Sacramento to Palo Alto, and, you know, that that would have been a good time to have thought about that particular issue. Right now we re kind of stuck with this world currently.

PRESIDING MEMBER BOYD: Don t get me going on land use planning in this state.

DR. SMITH: The Arctic may be a big area unexplored, but I think most oil companies disagree with you in that most oil companies have -- are not interested in a lot of the Arctic because it s mostly gas. I think gas is obviously -- and it will be explored for gas, which is fine. I have no problem with that.

But with the gas as reserves growth thing, I think, with respect, you re guilty of thinking that these foreigners overseas haven t done a good job. And I certainly -- like the Russians and the Chinese, they have drilled their fields up more intensely than Midway Sunset, if you look at their major fields. And I don t think even Saudi Aramco -- they re not stupid. They re perfectly capable of doing the work. And they have been but they --

DR. GAUTIER: But they don t need to, you see, because they re trying to hold production down. They don t need to produce. They want to produce less.

DR. SMITH: Yeah, they have been ordered to produce down, but around 70 percent of their oil comes from one field, which was discovered in 1948 or something like that.

DR. GAUTIER: With some spotted in 1894.

DR. SMITH: Exactly. And it s declining.

MR. ESKEW: Well, let me just as just a practical test. The issue is, A, do we have to worry about it, and B, when do we have to worry about it. You know, if you look at the world around you, and Sarah alluded to production forecast, it was very similar to how we do it.

And a lot of it is looking at what companies are doing, what countries are saying they re going to do, and where people are putting up pipelines. And if you just go through and count projects over the next seven to ten years, there is an enormous influence of new oil in the world oil market.

Now, five years from now if you do that same exercise again, and you don t find any projects, then you start to worry that maybe we are drilled up. But at this point there is so much activity, so much capital, so many projects going on, that it s very difficult to raise concern over the ultimate availability of the resource.

CHAIRMAN KEESE: So, your advice would be that in our deliberations on setting an energy policy for the State of California that supply should not be the driver?

MR. ESKEW: I think supply is an issue that is determined by the world market, and California needs to make sure that it s access to world supplies is not hampered by your policies.

CHAIRMAN KEESE: But it s infrastructure, it s environment, it s our other concerns that should be the driver in this issue.

MR. ESKEW: Right. And your concerns are, do we use that supply in a responsible or environmentally sound manner, can we bring it in an efficient and economic fashion.

MS. PHILLIPS: It s sort of like if you let -- in this case if you let supply be the driver in California, it s like heroin addicts sitting around wondering if you have enough opium fields. It s really knowing what to do --

MR. FINLEY: I think to get to the question of what should California be worried about, I mean, I would not say everything is fine in the world oil market and you don t need to worry about supply. I mean, I would say that supply disruptions are a way of life, and price volatility is something that the state and the federal government, and, you know, any -- and, you know and the whole world needs to be concerned about.

And frankly, I m more concerned about it now than I was a couple years ago because I think that OPEC is trying to hold the price too high, and that they re setting themselves and the rest of us up for a period of greater than average price volatility. I mean, some price volatility is not only normal but desirable, as the mechanism for which the market -- to which the market functions.

But too much volatility, you know, is

very damaging to both producers and consumers, frankly. And unfortunately, that s the situation that I fear we are in with OPEC s efforts to hold prices above what we think is a sustainable price. And, by the way, that the gas market is likely to be even worse in terms of price volatility.

And so then the question is, you know, what role is there for governments? You know, what do governments do about that? You don t want to -- I don t think it should be objective of policy to remove all volatility, because that would remove market signals and make the markets much less efficient and dangerous.

But I think there are things that governments can do through smart policy on both, you know, the production and the consumption side to promote -- to reduce vulnerability, to promote offsets and substitution. And these are things that will help smooth those excessive peaks and troughs out of the marketplace.

And I would say that if I were sitting here in California -- well, I know sitting myself in Washington, that s one thing I m worried about, price volatility in the marketplace to an unusual degree in the near future.

PRESIDING MEMBER BOYD: I would say to BP s credit that BP sits at the table with those of us who participate in, you know, California s transportation future, i.e. the fuel cell partnership and hydrogen, the path to hydrogen, and the President of this country, no enemy of oil, has said that there must be something wrong out there because we need to plan for that future.

So there are interests in various corners in energy security, and obviously, not everybody thinks we ll have a solid hold in the Middle East all the time.

MS. EMERSON: Can I respond to your question about what we should worry about in the world market? I can say unequivocally, I wouldn t worry about crude oil supplies, but you are a quality island in auto fuels, and you re going to have volatile fuel prices for many more years, and you re going to have huge spikes year in and year out because you -- there are only so many refineries in the world who can meet your specification and deliver it when you ve had these spikes.

And once in the Gulf Coast are going to have a harder and harder time coming to your aid because their own capacity is being maxed out. So now you re talking about -- you re depending on this in Finland to take all the way around South America, or even, perhaps, they can go through the canal, and that, to me, is your biggest Achilles heel. As long as you remain the quality island that you are, the crude supply issue is minuscule in comparison in terms of your vulnerability to oil prices.

CHAIRMAN KEESE: I agree with you. That is number one, our number one vulnerability. I think number two is natural gas.

PRESIDING MEMBER BOYD: Well, I think when it comes to that question, we have to make other choices. I agree with that comment. I came in here thinking that was a problem and I m leaving here thinking that s still a problem, and that just means we have to make other choices, as I think you said earlier in response to my comment, in the transportation sector and what fuels of transportation, etcetera, etcetera.

We need to take that into account so we are more concerned about efficiency than the rest of the country is. And, you know, watch this space. We ll probably be pushing that subject a lot harder in the not too distant future. For -- that s just one of the things we ll have to do for that very reason.

I have no final -- oh, there was a question in the audience, Mr. Abelson.

MR. ABELSON: I guess I just wanted to voice one discomfort with the way the conversation has gone, at least from what I m hearing, and that s that the issue of whether there is a marked physical peak of some kind coming in the next decade or two is actually probably pretty critical to the decisions that the state can make. If there is any reason to think there was, even if substitution were the answer, and substitution has a lot of policy implications for it as well, you know, policy makers would want to know that.

And it seems to me that I ve been very struck by an approach that Dr. Smith is taking. And I don t know whether all of you are disagreeing with his approach or whether folks are talking past each other. As I hear the economists saying, well, in the past, you know, when the prices go -- when the supply gets short the price goes up, when the price goes up the exploration comes along, the technology innovates and we get more supply and it all just goes along.

And I think I heard Dr. Smith say, well, if you look at kind of what s out there, kind of hindcasting, I don t know if that s the right technical way to think of it, but kind of look at what s been going on for 100 years instead of just kind of looking forward to the way we ve been going, there is kind of an end to that train ride. And we have some reason to think that s coming sooner rather than later.

So my comment was simply to ask you folks if there is a possibility of finding out whether you really disagree with each other, or whether you re talking past each other.

DR. SMITH: That s a good point, actually, because most of the economic points that have been made I ve agreed with in every one of the presentations. The only problem I have is the supply theory. The rest I totally agree with. And, certainly, with comments you made about LNG for California makes a lot of sense, and working on substitutes for whatever reason makes a lot of sense too.

So on that side, I think I tend to agree with things that have been said apart from this point about unlimited resource. And my view is that oil and gas is finite, and by definition there will be a peak eventually to come.

MR. ESKEW: I guess I ll kick off the economist ball here. But, you know, in my view, there is a kind of a mix of humility and arrogance. I know I don t know what the geologists -- I know I don t know what the resource endowment really is. I also know that you don t know it and nobody knows it.

All I know, there is essentially what I can see people have been able to do with the resource endowment of the world. And while I agree theoretically, there is a limit to how much hydrocarbons can be extracted from the world.

I guess my basic disagreement is that I think the analysis that starts with saying, here is what I know and here is what the applications of that are, where I disagree with that is the here s what I know part. I think there is too much that we don t know to be able to conclude and say truly this is where the peak is.

I agree that from what I know, just as if you look at the Gulf of Mexico or you look at any other restricted region, you can do that analysis and you can come up with a very credible answer. It s when you span the scope to say, this is what the world can do, that I have a philosophical disagreement.

PRESIDING MEMBER BOYD: Well, I -- go ahead.

MR. FINLEY: Actually, I was going to ask Dr. Cavallo to --

DR. CAVALLO: Well, I guess I seem to be one of the few who believes what Don has done is correct, and that he has made -- his group has made a good effort to understand world resources. And if you look at what he says for resources for individual provences and compare them to production data, you see that it s about what you d expect.

You see places that, like the U.K., that have peaked. According to Don s assessment, they should be. There is not much more -- you know, you should be on the downslope. There s not that much more oil left there. The United States, the same thing. Although there is lots more oil in the Gulf of Mexico that you re getting at now with BP, that doesn t mean production is going to ramp up to 10 million barrels a day again. I mean, production really does peak.

And when you say you can t do this for the whole world, the whole world is just a sum of these individual provences. So when you start looking at these individual provences and you see production peaking, by gosh, you know, that s what s happening all over the world. One by one these provences plateau or peak.

So I think the problem is amenable to analysis. I think the USGS estimates are a good place to start with that analysis. And you -- if you re not convinced by -- California isn t convinced by my analysis or Dr. Smith s analysis, you can follow production trends. And I think the next five years will really tell you what s going on.

And unfortunately, as I indicated, price isn t a good indicator of what s going on, and that s really your problem that people only pay attention to price, and so you re going to have to find a way to give that signal. But I think you can clearly see a problem, not in the next five years, but possibly in the next 10, and certainly in the next 20. That would be my --

And you can -- it s not just that I m

pulling this out of the blue. I based this on what s happening today in these different oil provences.

DR. GAUTIER: Forgive me, though, aren t -- we have to either be predicting geology or price. We can t say, well, the geology -- I can t -- I misunderstood the argument, because aren t you, in fact, predicting that there is a price -- huge price spike that s coming up. Isn t that what you re predicting?

DR. CAVALLO: No, no, no.

DR. GAUTIER: But if there isn t a price spike, then who cares?

DR. CAVALLO: Oh, it will be -- prices will start to rise, and that s what I did discuss that in my talk. It depends on how you approach it.

DR. GAUTIER: But I mean the only issue -- the only reason we care about producing oil is because we use it, and the problem with running out of supply is that the price, as I understand it, would go non-linear, and then we re stuck with a huge price, correct? So, you re predicting a high price?

DR. CAVALLO: Ultimately.

DR. GAUTIER: In 2010?

DR. CAVALLO: What I said in my talk was that it depends on how you approach this peak. Okay? If the present system stays together and OPEC remains the swing producers -- I think we all know OPEC is the swing producer. They re reduced production substantially in the last couple of years to maintain the price. That s easily visible. Okay? OPEC is the swing producer.

Now, if that -- that system stays in place and non-OPEC peaks, as I think it will in say 10 years, probably around 10 years, then OPEC will be in control of the market after that, and they will continue to supply increasing quantities, but the price will go up gradually. They re not interesting in wrecking the system. They want to maintain the world economy. They re not out to destroy everyone.

So they ll give you time to adapt to the new regime. So that was one scenario I had. My big worry is that what will happen is the United States will seize control of Iraq. As you mentioned, the production potential of Iraq is enormous. And they will ramp production up to six million barrels a day.

And OPEC may not hang together, as you were assuming that OPEC will remain in control of the market. If they re not the price will go to $10 a barrel or lower, and that will be a real problem because consumption will increase. People just love cheap oil. And it will wreck BP. BP won t like $10 a barrel. They didn t like it 98, did they?

MR. FINLEY: Oh, no.

DR. CAVALLO: Okay. Well, that s --

MR. FINLEY: We re not advocating that.

DR. CAVALLO: Those are the two scenarios that I presented, and I think, you know, you can pick which one you like. I think I like the OPEC scenario, but I can t say right this instant what will happen, but I am afraid that the non-OPEC ramp up in price will occur. And --

DR. GAUTIER: I guess what my complaint is here is that we have -- now the geologists are making -- I mean, the geologists are making the economic prediction here. And that, in fact, is what your prediction is. And the economists don t see the signals.

You know, if we really knew -- if we knew that in the year 2010 we re going to have an oil shortage, well, then, I ll talk with the smart people and we ll buy some futures somewhere and we ll do a deal, you know, and the price will start rising. Even in my limited understanding, the prices started rising now in anticipation of that, right?

DR. CAVALLO: Uh-hmm.

DR. GAUTIER: So, I guess what you re arguing is that you, in fact, know more about the resource than anybody, and only you and you --

DR. CAVALLO: No. You too. You too.

DR. GAUTIER: -- have an understanding of what --

MR. FINLEY: I think there is a fundamental disconnect, and the fundamental disconnect is that, and I hope this isn t an unfair characterization -- I think of the world s resources as flexible. It is not -- the amount that is ultimately recoverable, in terms of the reserve base of the world, depends on price and technology.

And what I ve heard, you know, from Drs. Cavallo and Smith is price doesn t matter. There is a fixed amount of oil that can be accessed, you know. And what I thought I heard from Dr. Gautier was, you know, that the way the USGS thinks of its own assessments that form the baseline for all of the discussion that we ve had here, is as an estimate based on a single assumption about price and a single assumption about technology, and that if you change the price assumption or if you change the technology assumption, the resource base changes too.

And the history has been that technology changes, prices come down and allow you to get at a bigger, bigger chunk of that resource pyramid that he showed. And so I think that the debate, does that resource pyramid change over time with changes in technology and price, or does it not? And I would say that that s the cornel of the disagreement that you re hearing here.

DR. CAVALLO: It hasn t changed in the United States. I mean, you saw prices triple when OPEC took control of the market, and, you know, production did not come back in the United States. So it didn t drop off a cliff. Okay? You re not going to drop off a cliff. That s what I m saying. I m not preaching gloom and doom.

What I am saying is that there are limits, and we can cope with those limits, and we can look at production, we can look at resource bases and we can cope, but we have to be willing to cope.

MR. ESKEW: Certainly, the lower 48, you know, doesn t have any flexibility, but geology rules in the lower 48. I don t know --

DR. CAVALLO: It rules everywhere.

MR. ESKEW: -- who would want to disagree, but only because it hasn t had to. But with the other issue is it s not only the concept of is the resource flexible or finite, it s also, what is the resource? Is it -- if you re just talking about conventional oil, then maybe your numbers are falling off, but there is a lot more to supply than conventional oil.

You know, there is probably -- if the world really needed to exploit it, there is probably 15 million barrels a day of oil sands that could be produced based on the billions of barrels of existing resource. You know, in 1980 by wife was designing plants, coal gasification plants. It still runs today. You know, it actually does pretty good at $5 gas. But, you know, we got plenty of coal.

Supply is not the issue. It s how much

supply can you produce at a given price.

DR. SMITH: Yeah, well I am just talking about oil and about conventional oil. I m not talking about (inaudible) either. Maybe there are plots that (inaudible) but actually there is a long period of slow decline. And so of course there is substitutes, but the problem here I don t think is -- I don t really disagree with the USGS on their resources estimate. I might be a little bit low. You ve got 3,000 billion and I ve got 2,500 billion, but it s just -- it s within error.

But the problem, I think is the rate in which production can be brought onstream. That s the key, I think. And as soon as the world is aware of it, it might potentially be a beginning of decline in conventional production, but better for the future. And that substitutes can be brought onstream.

I mean, the oil sands, they re not new things. They ve been around for 25 years. Sunco have been doing it for years and years and struggling with problems with technology and problems with price, problems with gas supply, because as soon as oil prices go up gas is going to go up too, which will make them much less economic.

MR. ESKEW: You should see their stockpile.

PRESIDING MEMBER BOYD: We have a question from the audience, finally.

MR. MATTHEWS: I m Scott Matthews. I m with the Energy Commission. I ve been listening to the debate all day. It s been fascinating. I think it was Kathryn that summarized it well, that we know it s declining and not declining, and that there will be a peak and not be a peak.

And listening about this whole discussion you ve just been having about price and the supply reacting to price. But on the same token you re saying that the price is artificially high because OPEC is restricting demand -- restricting supply, therefore, keeping the price high, reducing demand from what it would normally be if you had a totally well-functioning competitive market.

So, therefore, we ought to be producing a lot more oil now than the economics would call for, right? Because you re making a lot of money producing oil, if you re not OPEC. You ought to be -- the California oil fields ought to be seeing a price that they would never see if we -- if it weren t for OPEC. And why is there a decline in California and a decline in the United States, and a decline in these places if Dr. Smith is right that they re, in fact, declining. I haven t heard anybody say they disagree with you, so that s an open question.

But I m just sort of trying to weigh all that and would like to hear responses to that, to the issue. If you re seeing artificially high price, why isn t, you know -- if we go down to what the real price would be, we wouldn t see a price signal.

DR. CAVALLO: That was my point, actually, that you would see a price signal. That the price is -- the market price is decoupled from production costs. If you let Saudi Arabia, somebody else said this too, if you let Saudi Arabia produce what it could you wouldn t have an oil industry in the Gulf of Mexico.

Is that what you want? Well, I don t think so. But Saudi oil is dirt cheap. 1,500 wells, you know, that s all they need.

DR. GAUTIER: In the California fields I would submit to you that by in large the major companies, the capital and expertise of which would be required, decided long ago they simply weren t going to explore and do work in California, because -- from the point of real exploration, because of all the reasons and the decisions that are made. You don t explore offshore. You really can t work in the LA Basin. What s left is the San Joaquin, and there they are just -- that is just a cash cow, and that money just flows out, and they really don t care about maximizing production.

That s not the issue. The issue is maximizing profit in those properties, and they are doing it, and they re doing it big time. And they re deciding on every dollar whether they re going to spend it on milking the resource out of -- the oil out of those fields in California or whether they re going to put it -- where else they ll put it.

And I think to push out to lower quality, higher cost resources in California doesn t look as attractive to them as taking that same capital and putting it wherever, either Azerbaijin or offshore West Africa. Something like that. That would be my answer. They don t care to maximize -- they don t care if they maximize production in California. They don t care to maximize production in California. It s not their thing.

DR. CAVALLO: They re maximizing profit.

DR. GAUTIER: That s right.

DR. CAVALLO: That s what they want.

MR. FINLEY: I prefer to think of it as shareholder returns.

DR. CAVALLO: All right. Sorry. Wrong euphemism. But, again, it s about money. I mean, this is -- this is about money, and there is a lot of money to be made in oil, and, you know, as long as OPEC can maintain that price, you guys are doing just fine. If they can t maintain the price, then you folks are in big trouble.

PRESIDING MEMBER BOYD: I m suddenly beginning to envy the position that California is in in that it is momentarily independent from the world because I m beginning to conclude that we have kind of turned a corner, and we re going to have to kind of make our own kinds of decisions here, and check in on this world to be every two years to make sure that we re still in step.

I want to thank all of you for what, to

me, has been an absolutely stimulating day, and unbelievably interesting subject. I hate to return to the real world tomorrow morning.

And California, I think, through this event today, has dug deeper into the subject than perhaps it ever has. And through both legislative direction and maybe as a result of (inaudible) I think this agency will dig deeper into the subject in perpetuity than it has in the past. So I look forward to us having future discussions with all of you in whatever form it might be. And, again, thank you very much for the contributions you ve given us today.

I don t find myself necessarily disagreeing with anybody. I find that a very comfortable position because it s -- Kathryn did summarize things well. It still is a subject in flux, and maybe California doesn t have to deal with it quite as much as I thought we did coming into the day. Thank you, very much. Have a good evening everybody.

(Whereupon, at 5:15 p.m., the workshop was adjourned.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 10th day of May, 2003.

PETER PETTY